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THE CONTEMPORARY EVOLUTION OF MAN.

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In the past decade of practical research and speculation in biology two subjects have outstripped in interest and importance the rapid progress all along the line. These are, first, the life-history of the reproductive cell from its infancy in the ovum onward, and second, the associated problem of heredity, which passes insensibly from the field of direct observation into the region of pure speculation.

As regards the cell it was generally believed that the nucleus was an arcanum into the mysteries of which we could not far penetrate; but this belief has long been dispelled by the eager specialist, and it is no exaggeration to say that we now know more about the meaning of the nucleus than we did about the entire cell a few years ago. At that time the current solution of the heredity problem was a purely formal one; it came to the main barrier, namely, the relation of heredity and evolution to the reproductive cells, and leapt over it by the postulate of Pangenesis. The germ-cell studies of Balfour, Van Beneden, the Hertwig brothers, Weismann, Boveri and others have gradually led us to hope that we shall some day trace the con-

[1]Delivered before the Alumni of the College of Physicians and Surgeons, New York, February 12th, 19th, 26th.

nection between the intricate metamorphoses in these cells and the external phenomena of heredity, and more than this, to realize that the heredity theory of the future must rest upon a far more exact knowledge than we enjoy at present of the history of the reproductive cell both in itself and in the influence which the surrounding body cells have upon it.

These advances affect the problem of life and protoplasm, whether studied by the physician, the anthropologist or the zoologist, thus concentrating into one focus opinions which have been formed by the observation of widely different classes of facts. As each class of facts bears to the observer a different aspect and gives him a personal bias, the discussion is by no means ironical, and it is our privilege to live through one of those heated periods which mark the course of every revolution in the world of ideas. Such a crisis was brought about by the publication of the theory of Darwin, in 1858, and after subsiding has again been roused by Weismann's theory of heredity, published in 1883.

This is the situation I have ventured to present to you as Cartwright lecturer, not, of course, without introducing some conclusions of my own, which have been derived from vertebrate palæontology, but which I shall direct mainly upon human evolution.

So far as theories need come before us now, remember that Lamarck (1792) attributed evolution to the hereditary transmission to offspring of changes (acquired variations) caused by environment and habit in the parent. Darwin's latest view was that evolution is due to the Natural Selection of such congenital variations as favored survival, supplemented by the transmission of acquired variations. Weismann entirely denies the transmission of acquired variations or characters, and attributes evolution solely to the natural selection of the individuals which bear the most favorable variations of the germ or reproductive cells. We must, therefore, clearly distinguish between "congenital variations" which are part of our inheritance and "acquired variations" which are due to our life-habits; the question is, Are the latter transmitted?

Significance of Anomalies.—At the outset I would emphasize the extreme complexity of evolution by a few words upon Variation, or in terms of medical science, upon anomalies.

When we speak of a part as "anomalous" we mean that it varies at birth from the ordinary or typical form—it may be minute, as the small slip of a tendon, or large, as the addition of a complete vertebra to the spinal column. Wood has found that in the muscular system alone there are nine anomalies in the average individual. It is clear that the evolution of a new type, so far as the muscular system is concerned, must consist in the *accumulation of anomalies in a certain definite direction by heredity.* Thus the anomalous condition of one generation may become the typical condition of a very much later generation, and we observe the paradox of a typical structure becoming an anomaly and an anomalous structure becoming typical; for example, the supracondylar foramen of the humerus was once typical; it is now anomalous; the retardation in development of the wisdom tooth was once anomalous; it is now typical.

The same principle applies to races which are in different stages of evolution; an anomaly in the white, such as the early closure of the cranial sutures, is normal in the black. Now the deductions of the Weismann school of evolutionists seem to be founded upon the principle "*de minimis non curat lex;*" that we need only regard such major variations as can, *ex hypothesi*, weigh in the scale of survival. Against this I urge that we must regard the evolution of particular structures, the components of larger organs, the separate muscles and bones for example, for the very reason that while in some cases they play a most humble *rôle* in our economy we can prove beyond a doubt that they are in course of evolution. Minor variations in foot structure, which are possibly of vital importance to a quadruped whose very existence may depend upon speed, sink into obscurity as factors in the survival of the modern American.

The evolution of man in the most unimportant details of his structure promises, therefore, to afford a far more crucial test of the Lamarckian *vs.* the pure Natural Selection theory,

than in the domain of his higher faculties, for the reason that Selection may operate upon variations in mind, while it taxes our credulity to believe it can operate upon variations in muscle and bone. This is my ground for selecting the skeleton and muscles for the subject of the introductory lecture. Nevertheless, let us review variation in all its forms in human anatomy before forming an opinion. Let us remember, too, that congenital and acquired variations are universal as necessities of birth and life; they are exhibited in the body as a whole—in its proportions, in the components of each limb, finally in the separate parts of each component, as in the divisions of a complex muscle. Thus the possibilities of transformism are everywhere. What is the nature and origin of congenital variations? Their causes? Do they follow certain directions? Do they spring from acquired variations by heredity? These are some of the questions which are still unsettled.

But striking as are the anomalies from type, the repetitions of type as exhibited in atavism and normal inheritance are still more so, and equally difficult to explain. Therefore our theory must provide both for the observed laws of repetition of ancestral form and the laws of variation from ancestral form, as the pasture-land of evolution. Add to these, that for a period in each generation this entire legislation of nature is compressed into the tiny nucleus of the fertilized ovum, and the whole problem rises before us in the apparent impregnability which only intensifies our ardor of research.

The anthropologists and anatomists have enjoyed a certain monopoly of *Homo sapiens*, while the biologists have directed their energies mainly upon the lower creation. But under the inspiring influences of the Darwinian theory these originally distinct branches have converged, and as man takes his place in the zoological system, comparative anatomy is recognized as the infallible key to human anatomy.

For our present purpose we must suppress our sentiment at the outset and state plainly that the only interpretation of our bodily structure lies in the theory of our descent from some early member of the primates, such as may have given rise

also to the living Anthropoidea. This is also the only tenable teleological view, for many of our inherited organs are at present non-purposive, in some cases even harmful, as the appendix vermiformis.

From the typical mammalian stand-point man is a degenerate animal; his senses are inferior in acuteness; his upright position, while giving him a superior aspect, entails many disadvantages, as recently enumerated by Clevenger,[1] for the body is not fully adapted to it; his feet are not superior to those of many lower Eocene plantigrades; his teeth are mechanically far inferior to those of the domestic cat. In fact, if an unbiased comparative anatomist should reach this planet from Mars he could only pass favorable comment upon the perfection of the hand and the massive brain! Holding these trumps, man has been and now is discarding many useful structures. I refer especially to civilized man, who is more prodigal with his inheritance than the savage. By virtue of the hand and the brain he is, nevertheless, the best adapted and most cosmopolitan vertebrate. The man of Néanderthal or Spy, with retreating forehead and brain of small cubic capacity[2] was limited both in his ideas and his powers of travel, yet he was our superior in some points of osteological structure. But the period of Néanderthal was recent compared with that in which some of our rudimentary organs were serviceable, such as the vermiform appendix or the panniculus carnosus[3] muscle. These rudiments, in turn, are neogenetic when we consider the age of the two antique sense organs in the optic thalamus, the remnants of the median or pineal eye and the pituitary body, both of which were undoubtedly present, and probably useful, in the recently discovered Silurian fishes!

[1]Disadvantages of the Upright Position, article in AMERICAN NATURALIST, 1884, p. 1.

[2]The remarkable skulls and skeletons which have recently been discovered at Spy remove all doubts as to the normal *i. e.*, racial character of the famous Néanderthal skull, which were entertained by Quatrefages and others. See Fraipont and Lohest, Archives de Biologie, 1887, p. 697.

[3]This is an epidermal or twitching muscle in the quadrupeds.

I mention these vestiges of some of the first steps in creation to illustrate the extraordinary conservative power of heredity (which is even more forcibly seen in our embryological development), partly also to show how widely our organs differ in age. Galton has compared the human frame to a new building built up of fragments of old ones; extend this back into the ages and the comparison is complete.

Development, Balance, Degeneration.—It is probable that none of our organs are absolutely static and that the apparent halt in the development of some is merely relative, as where a fast train passes a slow one. The numerous cases of arrested evolution in nature are always connected with fixity of environment, an exceptional condition with man, and we have ample evidence that some organs are changing more rapidly than others.

Adaptation to our changing circumstances is mainly effected by the simultaneous development and degeneration of organs which lie side by side, as in the muscles of the foot or hand; in terms of physiology, we observe the hypertrophy of adaptive organs and atrophy of inadaptive or useless organs. This compensating readjustment, whereby the sum of nutrition to any region remains the same during redistribution to its parts, may be called metatrophism. It is the gerrymander principle in nature.

In practical investigation it is very difficult in many cases to determine whether an organ is actually developing or degenerating at the present time; although its variability or tendency to present individual anomalies indicates that some change is in progress. I may instance the highly variable peroneus tertius muscle (Wood). The rise or fall of organs is so constantly associated with their degree of utility that in each case the doubt can be removed by a careful analysis of the greater or less actual service rendered by the part in question. Apart from the question of causation it is a fixed principle that a part degenerating by disuse in each individual will also be found degenerating in the race.

Degeneration is an extremely slow process; both in the muscular and skeletal systems we find organs so far on the down grade that they are mere pensioners of the body, drawing pay (*i. e.*, nutrition) for past honorable services without performing any corresponding work—the plantaris and palmaris muscles for example. Of course an organ without a function is a disadvantage, so that the final duty of degeneration is to restore the balance between structure and function by placing it *hors de combat* entirely. One symptom of decline is variability, in which the organ seems to be demonstrating its own uselessness by occasional absence. As Humphrey remarks: "The muscles which are most frequently absent by anomalies are in fact those which can disappear with least inconvenience, either because they can be replaced by others or because they play an altogether secondary *rôle* in the organism." The stages downward are gradual; the rudiment becomes variable as an adult structure, then as a fœtal structure; the percentage of absence slowly increases until it reappears only as a reversion; finally the part ceases even to revert and all record of it is lost. This long struggle of the destructive power of degeneration, which you see is essentially an adaptive factor, against the protective power of heredity is the most striking feature of the law of Repetition. (See Galton's similar principle of Regression in Anthropology).

A careful study of our developing, degenerating, rudimental and reversional organs amply demonstrates that man is now in a state of evolution hardly less rapid, I believe, than that which has produced the modern horse from his small five-toed ancestor. As far as I can see the only reason why our evolution should be slower than that of the ancient horse is the frequent intermingling of races, which always tends to resolve types which have specialized into more generalized types. Wherever the human species has been isolated for a long period of time divergence of character is very marked, as will be seen in some of the races I refer to below.

To lighten the long catalogue of facts, gathered from many authors, I shall frequently allude to *habit*, but will ask you to consider it for the time as associational rather than casual.

Pouchet says: "Man is a creature of the writing-table and could only have been invented in a country in which covering of the feet is universal;" he should have added the "eating-table." From the average man our fashions and occupations demand the play of the forearm and hand, the independent and complex movements of the thumb and finger; the outward turning of the foot in walking. These are some of the most conspicuous features of modern habit.

The Skeletal Variations.[1]—In a most valuable essay by Arthur Thomson upon "The Influence of Posture on the Form of the Articular Surfaces of the Tibia and Astragalus in the Different Races of Man and the Higher Apes,"[2] we find clearly brought out the distinction between congenital variations and those which may be acquired by prolonged habits of life. It is perfectly clear from this investigation that certain racial characters, such as "platycnemism" or flattened tibia, which have been considered of great importance in anthropology, may prove to be merely individual modifications due to certain local and temporary customs. Thomson's conclusions are that the tibia is the most variable in length and form of any long bone in the body. Platycnemia is most frequent in tribes living by hunting and climbing in hilly countries, and is associated with the strong development of the tibialis posticus. The great convexity of the external condyloid surface of the tibia in savage races appears to be developed during life by the frequent or habitual knee flexure in squatting; it is less developed where the tibia has a backward curve and is independent of platycnemia. Another product of the squatting habit is a facet formed upon the neck of the astragalus by the tibia. This is very rare in Europeans; it is found in the gorilla and orang, but rarely in the chimpanzee. We must therefore be on our guard to distinguish between congenital or hereditary skeletal characters which are fundamental and "acquired" skeletal variations which may not be hereditary. The latter

[1]For recent general articles see Blanchard, L'Atavisme chez l'Homme, Rev. de Anthrop. 1885, p. 425; and Baker, The Ascent of Man, Proceedings of the American Association for the Advancement of Science, 1890.

[2]Journal of Anatomy and Physiology, 1889, p. 617.

are of questionable value in tracing lines of descent, if not actually misleading; on the other hand, the teeth, as shown by Cope in his essay on "Lemurine reversion in human dentition," have distinct racial patterns and are reliable indices of consanguinity because their form cannot be modified during life.

The main features of present evolution in the backbone are the elaboration of the spines of the cervical vertebræ, the increase of the spinal curvatures, the shortening of the centra of the lumbar vertebræ and shifting of the pelvis upward, whereby a lumbar vertebra is added to the sacrum and subtracted from the dorso-lumbar series.

Cunningham[1] has found that the division of the neural spines in the upper cervical vertebræ distinguishes the higher races from the lower. The spine of the axis is always bifid, but the spines of the cervicals three, four and five are also, as a rule, bifid in the European, while they are single in the lower races. The same author shows[2] that the bodies of the lumbar vertebræ are altering, by widening and shortening, to form a firmer pillar of support, with a compensating increase in the length of the intervertebral cartilages. In the child the vertebræ present more nearly their primitive elongate compressed form. With this is associated an increase of the forward lumbar curvature (Turner);[3] the primitive (*i. e.*, Simian) curve was backward; even in the negroes the collective measurement of the posterior faces of the five lumbars is greater than the anterior, in the proportion of 106 to 100; whereas in the white the collective anterior faces exceed the posterior in nearly the same proportion—100 to 96.

The lower region of the back is also the seat of one of the most interesting and important of the changes in the body, namely, the correlated evolution of the inferior ribs, the lumbar vertebræ and the pelvis—to which embryology, adult and comparative anatomy and reversion all contribute their quota of proof. In most of the anthropoid apes, and therefore pre-

[1]Ibid., 1886, p. 636.
[2]Journal of Anatomy and Physiology, 1890, p. 117.
[3]Ibid., 1887, p. 473.

sumably in the pro-anthropos, there are thirteen complete ribs and four lumbar vertebræ, while man has twelve ribs and five lumbars. Thus we may consider the superior lumbar of adult man as a ribless dorsal; not so in the human embryo, however, for Rosenberg[1] has found a cartilaginous rudiment of the missing 13th rib upon the so-called first lumbar. Atavism contributes an earlier chapter in the history of this region, for Birmingham[2] reports, out of fifty cases examined in one year, two in which there were six lumbars, and in each the 13th rib was well developed; this is an interesting example of "correlated reversion," for as the pelvis shifted downward to its ancestral position upon the 26th vertebra the 13th rib was also restored. The other ribs are in what the ancients styled a "state of flux;" our 8th rib has been so recently floated from the sternum that, and according to Cunningham,[3] it reverts as a true rib in twenty cases out of a hundred, showing a decided preference for the right side. Regarding also the occasional fusion of the 5th lumbar with the sacrum and the unstable condition of the 12th rib, which is, by variation rudimentary or absent, Rosenberg makes bold to predict that in the man of the future the pelvis will shift another step upward to the 24th vertebræ and we shall then lose our 12th rib. The upright position and consequent transfer of the weight of the abdominal viscera to the pelvis may be considered the habit associated with this reduction of the chest; at all events, in the evolution of quadrupeds there is a constant relation of increase between the size of the posterior ribs and the weight of the viscera, until the rib-bearing vertebræ rise to twenty and the lumbars are reduced to three.[4] It would be interesting to note the condition of the ribs in some of the large-bellied tribes of Africans in reference to this point.

The coccyx has naturally been the center of active search for the missing flexible caudals. As is well known, the adult coccyx contains but from three to five centers, while the embryo contains from five to six. Dr. Max Bartels has made "Die geschwänzten Menschen" the subject of an exhaustive

[1]Morph. Jahrb., 1876.
[2]Journal of Anatomy and Physiology, 1891, p. 526.
[3]Ibid., 1890, p. 127.
[4]In the elephant and rhinoceros.

memoir upon cases of the reversion of the tail, while Testut records all the primitive tail muscles in various stages of reversion. Watson reports that the curvatores coccygia (-depressores caudæ) only occur in 1 in 1000 cases.

This suggests a moment's digression to consider the different phases of reversion. The 13th rib recurs by what Gegenbaur[1] calls "neogenetic reversion," for it is simply the anomalous adult development of an embryonic rudiment. Under neogenetic reversions many authors also include cases of the "arrested development," or persistence of an embryonic condition to adult life, such as the disunited odontoid process of the axis vertebra, which happens to repeat a very remote ancestral condition. I think such cases may illustrate a reversional tendency, although many cases of arrested development, such as anencephaly, have no atavistic significance whatever.[2] More rare and far more difficult to explain are the "palæogenetic reversions," in which the anomaly, such as the supracondylar foramen, reverts to an atavus so remote that the rudiment is not even represented in the embryo.

The features of skull development are primarily the increase of the cranium and the late closure of the cranial sutures in contrast with the more complete and earlier closure of the facial sutures.

So far as I can gather this seems to be another region where the white and colored races present reversed conditions; the early closure and arrest of brain development in the negroes is well known; the later closure among the whites is undoubtedly an adaptation to brain growth. In his valuable statistics upon the Cambridge students Galton says: "Although it is pretty well ascertained that in the masses of population the brain ceases to grow after the age of nineteen, or even earlier, it is by no means the case with university students. In high honor men headgrowth is precocious, their heads predominate over the average more at nineteen than at twenty-five."

Many of the cases of arrested closure of facial sutures are reversional, as they correspond with the adult condition of

[1]Morph. Jahrb., Bd. vi, p. 585.

[2]Anencephaly, it should be said, is frequently associated with numerous reversions.

other races, such as the divided malar or os Japonicum. The human premaxillary, a discovery with which Goethe's name will always be associated, is sometimes partially, more rarely wholly, isolated; it is late to unite with the maxillary in the Australians, and has been reported entirely separate in a New Caledonian child (Deslongchamps) and in two Greenlanders (Carus). The orbito-maxillary frontal suture, cited by Turner as a reversion to the pithecoid condition, is believed by Thomson,[1] after the examination of one thousand and thirty-seven skulls, to be merely an accidental variation, without any deeper significance. The development of the temporal bone from two centers, observed by Meckel, Gruber and many others, is considered by Albrecht a reversion to the separate quadrate of the sauro-mammalia. This I think is in the highest degree improbable (see "Limits of Reversion"). The open cranial and closed facial sutures are apparently associated with our increasing brain action and decreasing jaw action; in one case the growth is prolonged and the sutures are left open, in the other the growth is arrested and the sutures are closed.

Is the lower jaw developing or degenerating? This question has recently been the subject of a spirited controversy between Mr. W. Platt Ball,[2] representing the Weismann school, and Mr. F. Howard Collins,[3] supporting Herbert Spencer's view that a diminishing jaw is one of the features of our evolution which can only be explained by disuse. Mr. Collins finds that, relatively to the skull, the mass of the recent English jaw is one-ninth less than that of the ancient British, and roughly speaking, half that of the Australian. He appears to establish the view that the jaw is diminishing.

Closely connected with this is the evolution of the teeth; how are they tending? This we will consider below.

Variations of the Teeth.—Flower[4] has shown, as regards the length of our molar series, that we, together with the ancient

[1]Journal of Anatomy and Physiology, 1890, p. 348.
[2]Are the Effects of Use and Disuse Inherited? Nature Series, 1890.
[3]The Lower Jaw in Civilized Races, 1891.
[4]Journal of the Anthropological Institute, 1880.

British and Egyptians, belong to a small-toothed or "microdont" race; the Chinese, Indians (North American), Malayans and Negroes in part are intermediate or "mesodont," while the Andamanese, Melanasions, Australians and Tasmanians are "macrodont." While undersize marks the molars as a whole the wisdom tooth is certainly in process of elimination; it has the symptoms of decline; it is very variable in size, form and in the date of its appearance; is often misplaced, and is not uncommonly quite rudimentary (Tomes).[1] Here is another instance where the knife-and-forkless races reverse our degeneracy, for in them not only is the last normal molar (m. 3) large and cut long before the traditional years of discretion, but in the first two lower molars are found two intermediate cusps (Tomes)[2] which are variable or absent in us (Abbott); moreover, in the macrodont races a surplus molar[3] (m. 4) is sometimes developed. Mummery reports nine such cases among three hundred and twenty-eight West Africans (Ashantis). As an instance of associated habit I may here mention that Dr. Lumholtz, the Australian explorer, informs me that in adult natives the teeth are worn to the gum; in the absence of tools they are used in every occupation, from eviscerating a snake to cutting a root. A tour of inspection through any large collection of skulls brings out the contrast between the sound and hard-worn molars of the savage and the decayed and little-worn molars of the white.

Upon the descent theory the reduction of teeth in the progenitor of man began as far back as the Eocene period, for not later than that remote age do we find the full complement of three incisors and four premolars in each jaw; now there are but two remaining of each. Baume, a high authority, believes he has discovered eleven cases of a rudimental reversion of one of these lost premolars[4] not cutting the jaw. Not infrequently both these missing teeth occur by reversion! It is

[1]Dental Anatomy, p. 416.

[2]Op. cit., p. 416.

[3]This tooth has been found in several other macrodont tribes (Australians, Tasmanians, Neo-Caledonians), Fontan.

[4]Odontologische Forschungen, p. 268. This rudiment is found between the first and second normal premolars.

difficult to conceive of reversion to such a remote period, yet it is supported by other evidence. An embryonic third incisor has, I believe, been discovered. As long ago as 1863 Sedgwick[1] recorded a case of six upper and lower incisors in both jaws, and appearing in both the milk and permanent dentitions; this anomaly was inherited from a grandparent, a striking instance of hereditary reversional tendency. We might consider that these cases of supernumerary teeth belonged in the same category as polydactylism or additional fingers, which are not atavistic, but for the fact that they do not exceed the typical ancestral number, whereas the fingers do.

We owe to Windle[1] a careful review of the incisor reversions in which he shows that the lost incisors reappear more frequently in the upper than the lower jaw (coinciding with the fact that the lower teeth were the first to disappear in the race); he considers that the lost tooth was the one originally next the canine, and concludes by adding our present upper outer incisor to the long list of degenerating organs.[3] He supports this statement by measurements and by citing cases in which it has been found absent. Yet the reduction of the jaws is apparently outstripping that of the teeth, if we can judge from the frequent practice among American dentists of relieving the crowded jaw by extraction.

We now turn to the arches and limbs. Flower has pointed out that the base of the scapula is widening in the higher races, so that the "index," or ratio of length to breadth is quite distinctive. Gegenbaur associates this with the development of the scapulo-humeral muscles and the greater play of the humerus as a prehensile organ.

In general, the arm increases in interest as we descend toward the hand, both in the skeleton and musculature, because here we meet with the first glimpses of facts which enable us to form some estimate of the rate of human evolution. The well-known humeral torsion (connected with

[1]British and Foreign Medico-Chirurgical Review, 1863.

[2]Journal of Anatomy and Physiology, 1887, p. 85.

[3]Baume believes that the missing incisor is the primitive median one, while Turner believes it is the second. The fossil record supports Windle.

increased rotation) ascends from 152° in the polished stone age to 164° in the modern European. The intercondylar foramen or perforation of the olecranon fossa is exceptionally well recorded;[1] it is found in thirty per cent. of skeletons of the reindeer period; in the dolmen period it fell to twenty-four per cent.; in Parisian cemeteries between the fourth and tenth centuries it is found in 5.5 per cent.; it has now fallen to 3.5 per cent. The condylar foramen, occasionally forming a complete bridge of bone above the inner condyle and transmitting the median nerve and brachial artery, is known as the "entepicondylar" foramen in comparative anatomy, and is one of the most ancient characters of the mammalia; it reverts palæogenetically in one per cent. of recent skeletons, but much more frequently in inferior races (Lamb). In the wrist-bone is sometimes developed another extremely old structure—the os centrale. Gruber[2] reported its recurrence at .25 per cent. approximately. This is a case of neogenetic reversion, for Leboucq[3] shows that there is a distinct centrale in every human carpus in the first part of the second month, which normally fuses with the scaphoid by the middle of the third month.

The divergence of the female from the male pelvis is an important feature of our progressive development; it is proved by the fact that as we descend among the lower races it becomes increasingly difficult to distinguish the female skeleton from the male, for the pelves of the two sexes are nearly uniform. Here it seems to me is a most interesting problem for investigation. Arbuthnot Lane's[3] views of the mechanical causes of this divergence, which are strongly Lamarckian, may be weighed with the theory of survival of the fittest, for a large female pelvis is perhaps the best example that can be adduced of a skeletal variation which would be preserved by natural selection for reasons which are self-evident. The third trochanter of the femur is believed by Professor Dwight,[4] of

[1] See Blanchard, op. cit., p. 450.
[2] Virchow's Archiv, 1885, p. 353.
[3] Ann. de la Soc. de Med. de Gand, 1884.
[3] Journal of Anatomy and Physiology, 1888, p. 214.
[4] Ibid., 1890, p. 61.

the Harvard Medical School, to be a true reversion (one per cent.) in our race and not an acquired variation, as it is very frequently found among the Sioux (fifty per cent.), Laplanders sixty-four per cent., and Swedes thirty-seven per cent.; like the condylar foramen it is an ancient mammalian character.

The foot is full of interest in its association of degeneration and development with our present habits of walking; the great toe is increasing and the little toe diminishing, causing the oblique slope from within outward which is in wide contrast with the square toes in the infant or in the lower races. In many races the second toe is as long as the first, and the feet are carried parallel instead of the large toe turning out. If anyone will analyze his sensations in walking, even in his shoes, he will be conscious that the great toe is taking active part in progression, while the little toe is passive and insensitive. We are not surprised, therefore, to learn from Pfitzner[1] that we are losing a phalanx, that in many human skeletons (41.5 per cent. in women and thirty-one per cent. in men) the two end joints of the little toe are fused. The fusion occurs not only in adults but between birth and the seventh year, and in embryos of between the fifth and seventh month. The author does not attribute this to the mechanical pressure of tight shoes because it is found in the poorer classes. He considers it the first act of a total degeneration of the fifth toe.

Variations in the Muscles.—The evolution of the muscles of the foot looks in the same direction.

As you know, the large toe in many of the apes is set at an angle to the foot and is used in climbing. It is still employed in a variety of occupations by different races. According to Tremlett[2] the celebrated great toe of the Annamese, which normally projects at a wide angle from the foot, is contemptuously mentioned in Chinese annals of 2285 B.C., the race being then described as the "cross-toes." The long flexor of the hallux is apparently degenerating, showing a tendency to

[1]See Humboldt, 1890; also Nature, 1890, p. 301.

[2]Journal of the Anthropological Institute, 1880, p. 461.

fuse with the flexor communis: the abductors and adductors of this toe are also degenerating, the latter being proportionately large in children (Ruge). The little toe exhibits only by reversion its primitive share of the flexor brevis (Gegenbaur); more frequently it varies in the direction of its future decline by losing its flexor brevis tendon entirely. Two atavistic muscles, the abductor metatarsi quinti[1] (always present in the apes), and the peroneus parvus (Bischoff), also point to the former mobility of the outer side of the foot. In general the bones of the foot are developing on the inner and degenerating on the outer side, with loss of the lateral movements of the hallux and of all independent movements in the little toe. The associated habit is that the main axis of pressure and strain now connects the heel and great toe, leaving the outer side of the foot comparatively functionless.

The variations in the muscular system mark off more clearly the regions of contemporary evolution, and therefore are even more instructive than those in the skeleton. Muscular anomalies have, however, never been adequately analyzed. Even the remarkable memoir of M. Testut, "Sur les anomalies musculaires," is defective in not clearly distinguishing between variations which look to the future, those which revert to the past, and those which are fortuitous, for the author is strongly inclined to refer all anomalies to reversion.

The law of muscular evolution is specialization by the successive separation of new independent contractile bands from the large fundamental muscles, while the law of skeletal evolution is reduction of primitive parts and the specialization of articular surfaces. The number of muscles in the primates as a whole has, therefore, been steadily increasing, while the number of bones has been diminishing. In man the number of muscles is probably increasing in the regions of the lower arm and diminishing in every other region. The analysis is rendered very difficult by the fact that some muscles (*e. g.*, those connecting the shoulder with the neck and back) revert to a former condition of greater specialization when they were employed in swinging the body by the arms, and in quadru-

[1]Darwin: Descent of Man, p. 42.

pedal locomotion; while other muscles (*e.g.*, those connecting the forearm and fingers) revert to a former simpler arrangement when the hand was mainly a grasping organ, and the thumb was not opposable.

As in the skeleton, we find that muscular anomalies include, 1, palæogenetic reversions, or complete restorations of lost muscles; 2, neogenetic reversions, or revivals of former types in the relations of existing muscles; 3, progressive variations, which either by degeneration or specialization point to future types; 4, fortuitous variations, which cannot be referred to either of the above.

Duval observes that the flexor longus pollicis repeats in reversion all the stages of its evolution between man and the apes, in which it is a division of the flexor profundus. Gruber and others have even observed the absence of the thumb tendon. This is true of all the new muscles. Of this Testut writes: "Ne dirait-on pas, en le voyant s'éloigner si souvent de son état normal, que la nature voudrait le ramener à sa disposition primitive, luttant ainsi sans cesse contre l'adaptation, et ne lui abandonnant qu' à regret l'une de ses plus belles conquêtes."

Speaking of the hand, Baker[1] says: "On comparing the human hand with that of the anthropoids, it may be seen that this efficiency is produced in two ways—first, increasing the mobility and variety of action of the thumb and fingers; second, reducing the muscles used mainly to assist prolonged grasp, they being no longer necessary to an organ for delicate work requiring constant readjustment." You have noticed the recent discovery that the grasping power of infants is so great that the reflex contraction of the fingers upon a slender cross bar sustains their weight; this power and the decided inward rotation of the sole of the foot and mobility of the toes are persistent adaptations. Our grasping muscle, the palmaris longus, is highly variable and often absent; like the plantaris of the calf, it has been replaced by other muscles, and its insertion has been withdrawn from the metapodium to the palmar fascia. In negroes we frequently find the palmaris

[1]Op. cit., p. 299.

reverting to its former function of flexing the fingers by insertion in the metacarpals.

The rise of muscular specialization by degeneration is beautifully shown in the extensor indicis, which, while normally supplying the index only, reverts by sending its former slips to the thumb, middle, and even to the ring finger. Testut[1] believes that the extension power of the middle and ring fingers has declined, as the cases of reversion point to greater mobility; the extensor minimi digiti is distinct and highly variable (Wood), often sending a slip to the ring finger.

The entire flexor group of the hand, excepting the palmaris, is apparently specializing. The demonstration by Windle[2] and Bland Sutton, that the origin of the flexors and entensors is shifting downward from their original position, is evidence of an adaptation to the short special contractions required of them.

The abductor pollicis[3] is also progressive and variable (Wood); the reduplication of its inferior tendon, which is sometimes provided with a distinct muscle, apparently points to the birth of a second abductor. The opponens of the thumb is well established and constant. Variability seems to characterize both the developing and degenerating muscles; the latter are apt to be absent; it is rare that an important muscle, such as the extensor indicis, is absent, but such cases are reported.

It is interesting to note that the lost muscles of the body are almost exclusively in the trunk or shoulder, and pelvic arches, and not in the limbs. It will be remembered that the human shoulder-joint is exceptionally rigid, whereas in the quadrupedal state it was a factor in progression. Some of the muscular reversions in this quadrupedal region are the levator claviculæ (1 to 60, Macalister), trachelo-clavicularis, scalenus intermedius, acromio-basilaris (Champneys), transversus nuchæ (Gegenbaur). Apparently associated with the former swinging of the body by the fore-limb in the arboreal life are the

[1] Op. cit., p. 564.
[2] Journal of Anatomy and Physiology, 1890, p. 72.
[3] Or extensor ossis metacarpi pollicis. See Testut, p. 553.

atavistic coraco-brachialis-brevis (Testut), the epitrochleo-dorsalis (Testut), and pectoralis tertius (Testut).[1]

Centers of Variability.—As the literature is so readily accessible I will not multiply illustrations of the innumerable congenital variations related to human evolution. I call attention to several important inductions. First, there are several centers in which both the skeletal and muscular systems are highly variable. Second, that the most conspicuous variations, and therefore the most frequently recorded, are reversions. Third, that structure lags far behind function in evolution.

The conclusions of Wood and Testut[2] are that variability is independent of age or sex, of general muscularity, and of abnormal mental development. Wood found 981 anomalies in 102 subjects; of these, 623 were developed upon both sides of the body, while 358 were unilateral. Of still greater interest are the statistics collected by Wood between 1867–68 in the dissecting-room of King's College, upon 36 subjects (18 of each sex). These show that there are more anomalies in the limbs than in the trunk; that anomalies are rare in the pelvis; that there were 292 anomalies in the anterior limbs to 119 in the posterior; that in both limbs the anomalies increase toward the distal segments, culminating in the muscles of the thumb, where they rise to ninety per cent. (mainly flex. long. pollicis, and abd. long. pollicis). These facts seem to prove conclusively that while variation is universal it rises to a maximum in the centers where human evolution is most rapid; here are Herbert Spencer's conditions of unstable equilibrium. This has a direct bearing, as I shall show, upon our theory of heredity.

Fortuitous Congenital Variations.—I have thus far considered only those variations which apparently have a definite relation to the course of human evolution. There is an

[1]Quain describes seventy anomalous muscles (Anat., Vol. I.) Testut describes a still larger number.

[2]Op. cit., p. 760.

entirely different class of congenital variations which may be described as fortuitous or indefinite because they do not occur in any fixed percentage of cases; they are liable to take any direction; they cannot be considered reversional because they are not found in the hypothetical atavus, and there is not sufficient evidence to cause us to consider them as incipient features of our future structure.

Some may not be truly congenital (*i.e.*, springing direct from the germ-cells) but may be merely deviations from the normal course of development. I may instance the variations in the carpus recorded by Turner[1] in which the trapezium and scaphoid unite, or the trapezoid and semi-lunar divide, or the astragalus and navicular unite (Anderson).

The best examples of fortuitous congenital variations are seen in supernumerary fingers and vertebræ. The eighth cervical vertebra, bearing a rudimentary rib,[2] is not a reversion because the most remote ancestors of man have but seven cervicals. In cases where a rib is developed upon the seventh cervical, however, the reversion theory is perhaps applicable because rib bearing cervicals are relatively less remote. The same distinction applies to polydactylism. How absurd it is to consider a sixth finger atavistic, when we remember that even our Permain ancestors had but five fingers.

We cannot, however, class as purely fortuitous a variation which occurs in a definite percentage of cases presenting twenty-four different varieties, but occurring in the same region. Such is the much-discussed[3] musculus sternalis, a muscle extending vertically over the origin of the pectoralis from the region of the sterno-mastoid to that of the obliquus externus. Testut lightly applies his universal reversion theory, and as this muscle is not found in any mammal considers it a regression to the reptilian presternal (Ophidia)! Turner also considered it as reversional in connection with the panniculus carnosus, the old twitching muscle of the skin, which plays so many freaks of reversion in the scalp and neck; this

[1]Journal of Anatomy and Physiology, 1884, p. 245.
[2]Arb. Lane: Journal of Anatomy and Physiology, 1885, p. 266.
[3]See Turner, Shepherd, and Cunningham: Journal of Anatomy and Physiology.

view is negatived by the fact that this muscle is innervated by the anterior thoracic (Cunningham, Shepherd) which would connect it with the pectoral system, or by the intercostal nerves (Bardeleben). Although the high percentage of recurrence in the sternalis in anencephalous monsters (ninety per cent. according to Shepherd) supports the reversion view, it is offset by the high percentage (four per cent.) in normal subjects, for this is far too high for a structure of such age as the reptilian presternal. Cunningham has advanced another hypothesis, first suggested by the frequency of this anomaly in women, that this is a new inspiratory muscle, having its origin in reversion, but serving a useful purpose when it recurs, and therefore likely to be perpetuated.

These fortuitous variations, as well as variations in the proportions of organs, play an important part in the present discussion upon heredity, for it is believed by the Weismann school that such variations, if they chance to be useful, will be accumulated by selection and thus become race characters.

The Limits of Reversion.—There is such a wide difference of opinion upon the subject of reversions that it is important to determine what are some of the tests of genuine reversions? How shall we distinguish them from indefinite variations or from anomalies like the sternalis muscle, which strain the reversion theory to the breaking-point?

Testut,[1] Duval, and Blanchard take the extreme position that almost all anomalies reproduce earlier normal structures, and that the exceptions may be attributed to the incompleteness of our knowledge of comparative anatomy. I may here observe that popular as the descent theory has recently become in France, neither these anthropologists nor the palæontologists show a very clear conception of the phyletic or branching elements in evolution. If they do not find a muscle in the primates they look for it in other orders of mammals. Now, since these other branches diverged from that which gave rise to man at a most remote period, the dis-

[1]Op. cit., p. 4.

covery of a similar muscle may be merely a coincidence; it is by no means a proof of reversion.

The first test of reversion is therefore the anatomy of the atavus, and this is derived partly from the palæontological record of the primates, partly from the law of divergence, viz., that features which are common to all the living primates were probably also found in the stem form which gave rise to man; finally, from the comparative anatomy of the living anthropoidea.

The second test is whether a structure passes the limits of reversion as determined by cases of atavism in which there can be no reasonable doubt. Two of these phenomena have recently been discussed, which seem to extend the possibilities of reversion back to structures which were lost at a very remote period. I refer to papers by Williams and Howes. Williams[1] has analyzed 166 recorded cases of polymastism; he finds that supernumerary nipples of some form occur in two per cent., and that in all except four of the cases examined the anomalies, tested by position, etc., support the reversion hypothesis. In the living lemurs, which form a persistent primitive group of monkeys, we find that the transition from polymastism to bimastism is now in progress by the degeneration of the abdominal and inguinal nipples, it is fair to assume that the higher monkeys also lost their abdominal nipples at a primitive stage of development, and therefore that cases of multiple nipples indicate reversion to a lower Eocene condition! Howes[2] has recently completed a most interesting study of the "intranarial epiglottis," or cases in which the epiglottis is carried up into the posterior nares, as in young marsupials and some cetacea, to subserve direct narial respiration. This has now been observed to occur by reversion in all orders of mammals, including the monkeys and lemurs. One case has also been reported by Sutton of its occurrence in a human fœtus. This is apparently a human reversion to a structure much older than the age of the lemurs.

The third test is the inverse ratio to time. It would seem, *a priori*, that the percentage of recurrence of atavistic structures

[1]Journal of Anatomy and Physiology, 1891, p. 224.

[2]Ibid, 1889, p. 587.

should decrease as the extent of time elapsing since the structure disappeared increases. This law is apparently established in the case of the condylar and intercondylar foramina, and if we examine all the percentages which have been established, we see at once that they bear a ratio to time; compare the relative frequency of the ischio-pubic (fifty per cent.), dorso-epitrochlearis (five per cent.), and levator-claviculæ (1.66 per cent.) muscles with the periods which have elapsed since their past service. This is why it is so important to establish percentages for all our atavistic organs; fuller statistics will not only bear upon heredity, but I can conceive of their application to the extremely difficult problem of estimating geological time. We must, of course, establish as a standard cases of congenital variation in which the frequency of recurrence has been steadily declining in the same race between two known periods of time—an available structure is the intercondylar foramen or supratrochlear foramen, as recorded by Blanchard, Shepherd and others.

The reversional tendency is hereditary. There are many cases, both of reversions (as in the teeth) and indefinite variations being hereditary, that is, reappearing in several generations, or skipping a generation and recurring in the second.

Summary.—There are clearly marked out several regions in the human body in which evolution is relatively most rapid, such as the lower portion of the chest, the upper cervicals, the shoulder girdle in its relation to the trunk, the lower portion of the arm and hand, the outer portion of the foot. We notice that these regions especially are centers of adaptation to new habits of life in which new organs and new relations of parts are being acquired and old organs abandoned.

We observe, also, that all parts of the body are not equally variable, but these centers of evolution are also the chief centers of variability. The variations here are not exclusively, but mainly, of one kind; they rise from the constant struggle between adaptation and the force of heredity. Here is a muscle like the extensor indicis attempting to give up an old function and establish a new one; it maintains its new func-

tion for several generations and then goes back without any warning to a function which it had thousands of years ago. Thus the force of reversion strikes us as a universal factor.

Now the singular fact about reversion is the frequent proof it affords of what Galton has called "particulate inheritance." When the extensor indicis reverts all the muscles around it may be normal; therefore we are obliged to consider each of these muscles as a structure by itself, with its own particular history and its own tendencies to develop or degenerate. Thus it is misleading to base our theory of evolution and heredity solely upon entire organs; in the hand and foot we have numerous cases of muscles in close contiguity, one steadily developing, the other steadily degenerating. Reversion very rarely acts upon many structures at once; when it does we have a case of diffused anomaly, some repetition in the epidermis or in the entire organism of a lower type. Yet in spite of reversion and the strong force of repetition in inheritance, the human race is steadily evolving into a new type. We must, it seems to me, admit that an active principle is constantly operating upon these particular structures, guiding them into new lines of adaptation, acting upon widely separate minor parts or causing two parts, side by side, to evolve in opposite directions, one toward degeneration the other toward development.

I may now recall the two opposed theories as to what this active principle is:

The first, and oldest, is that individual adaptation, or the tendencies established by use and disuse upon particular structures in the parent are, in some degree, transmitted to the offspring, and thus guide the main course of variation and adaptation.

The second is that all parts of the body are variable, and that wherever variations take a direction favorable (that is adaptive) to the survival of the parent they tend to be preserved; where they take the opposite direction they tend to be eliminated. Thus, in the long run, adaptive variations are accumulated and a new type is evolved.

Partial Table of Characters in Evolution.

Principal Regions of Evolution.	Developing Organs.	Degenerating Organs.				
		Retrogressive.	Variable.	Rudimentary (occasionally absent)	Reversional (from embryo).	Reversional (from germ-cells).
Skull and jaw.	Cranium.	Facial sutures.			Premaxillary.	
Spinal curvatures.		Infer. maxilla.				
		Hyoids.	Lumbars and pelvis.	Coracoid.		
Cervicals, lumbars, and coccyx.	Female pelvis.		Coccygeal vert.	4th and 5th caudals.	5th and 6th caudals.	Caudals +
Lower ribs.		8th rib.	12th rib.		13th rib.	7th cerv. ribs.
Scapula and lower humerus.	Scapula.					Condylar for.
	Clavicle.					S. trochlear. for.
Outer side of pes.	Hallux.	4th and 5th digits of pes.	Terminal phalanx of 5th dig. of pes.			3d trochanter.
	Tibia.				Centrale-manus. Intermedium, pes.	
Teeth......	......	Canines......	......	......	? Lateral incisor.	......×......
		Incisors, lateral sup.			? Third premolar.	4th premolar.
		3d molar.	3d molar.			
Flexors and extensors of arms......	Flex. prof. and perf.	......	......	Paniculus carnosus.	......×......	Trans. nuchæ.[1]
	Extensor indicis.	Muscles of mastica'n				Epitrochl. dors.
	Flex. long. pollicis.					Acromio-basilar.
	Abd. long. pollicis.					Levator-claviculæ.
	Flex. long. hallucis.					Pect. tertius.
						Cor. brach. brev.
		Pyramidalis.				Ischio-pubic.
Shoulder to trunk.	Triceps extensor surae.	Psoas parvus.				Depressores caudæ.
Trunk to femur.						Scansorius.
	Glutæal group.	Abd. and add. hallucis.	Muscles, 5th toe.	Plantaris.		Abd. metars. 5th.
	Facial group.			Palmaris.		Peroneus parvus.

[1] It is probable that some of these muscles are represented in the fœtus.

It is evident at once, from a glance over the facts brought forward in this lecture, that the first theory is the simplest explanation of these facts; that use and disuse characterizes all the centers of evolution; that changes of structure are slowly following our changes of function or habit.

But while the first explanation is the simplest it by no means follows that it is the true one. In fact, it lands us in many difficulties, so that I shall reserve the *pros* and *cons* for my second lecture upon Heredity. The Lamarckian theory is a suspiciously simple explanation of such complex processes.

(*To be continued.*)

NOTE.—Since this lecture was written I have received copies of Topinard's "L' Homme dans la Nature," Paris, 1891, and of Wiedersheim's "Der Bau des Menschen als Zeugniss für seine Vergangenheit." The latter is full but not critical.

MENTAL EVOLUTION IN MAN AND THE LOWER ANIMALS.

By Alice Bodington.

The science of Psychology is at last emerging from the cloudland of Metaphysics in which it has been enveloped from immemorial ages. Deep would be the folly of the man who would declare that we know what mind or consciousness really *is*, but at least we are beginning to understand something of its phenomena on the physical side, and to recognize that even the human mind is a product of evolution. Whether an impassable gulf, or a rubicon which can be boldly and safely crossed, separates the human mind from mind in the lower animals, is still a moot point with men of the highest scientific repute.

I do not for a moment pretend to approach the question from the high metaphysical point of view, but only to apply to the subject the same method which has so successfully been applied in biology; to put theories on one side, until we have ascertained as many ordinary facts as possible. In biology the greatest triumphs have been obtained by the demonstration that ontogeny, the history of the individual, is a guide to phylogeny—the history of the race. And in examining the history of the race, we find the development of the lower species of animals an invaluable guide in understanding the development of the higher species. Moreover if we wish to understand the peculiarities of domesticated animals, we must study the habits of their wild relations. These three guides we may take in studying the development of the human mind; in the child we may study its ontogeny; in the development of intelligence in animals we can observe the dawn of faculties which attain their supreme expression in man; and in the more primitive or savage races of man, we may see the germ which contained the nucleus of our civilization.

In the child, we find at the beginning of life a mental condition as low as that of a blind puppy or a kitten, showing two instincts only,[1] of which one has but lately been revealed; and no glimmerings, for many months, of reason. From this humble beginning, to the highest point which human faculties can reach, there is no break; no point at which we can say "here mind exists, where yesterday it was not." Not only is the growth of the human mind gradual, but during its earlier phases of development it assuredly ascends "through a scale "of mental faculties parallel with those permanently presented "by the lower animals, whilst with regard to the emotions the "area these cover in the lower animals is nearly co-extensive "with that covered by the emotional faculties of man.[2]" The purely human *emotions* may indeed be limited to religion and the sense of the sublime.

And if from the history of the individual, we turn to all we know of the history of the race, the evidence of a gradual evolution of mental faculties is the same; from the rough flint weapons of the drift period, to the era of polished stone; from polished stone to bronze; from bronze to iron; from the fetich of shapeless wood stuck with feathers, and the merciless nature-gods, which men saw in sunshine and storm, in famine and in pestilence, to the Brahma of the Vedas and the God of Isaiah; from the rude sticks covered by skins of animals, and shelters of rough piled stones, to houses of wood and hewn stone, and thence to such conceptions as are embodied in the Parthenon, or in the Cathedrals of the middle ages we have similar evidences of evolution. And whatever point of view we take we see progress starting from the humblest beginnings; no matter how towering the building, its foundations are laid deep in the earth.

It has been alleged that this very progress in human affairs draws a shape line of demarcation between men and animals; that whereas in man a constant improvement goes on, no sign of progress can be found in brutes. This argument is weak

[1]The instinct, pointing surely to an arboreal ancestry, by which a new born infant will cling to a support unaided.

[2]Romanes: Mental Evolution of Man.

on both sides. On the one hand though constant, and even rapid improvement, is a characteristic of certain races of men, yet there are numerous races whose improvement is either stationary or incredibly slow. They are to other men, what the Lingula, which has remained unchanged since Cambrian times is to other invertebrates. There are savages still in the age of unpolished stone; savages whose religion is the lowest fetich worship; savages whose only refuge is a skin spread over a few sticks, and others to whom any kind of shelter is unknown. Some progress they have all made from the furry arboreal animal with pointed ears, but it has been a progress immeasurably behind that of the higher races of man. "Rapid and continuous improvement," in the words of Mr. Romanes, "is a characteristic of only a small division of "the human race, during the last few hours, as it were, of its existence." The wonder is that with articulate language, man should have improved so slowly.

On the other hand it would be impossible to deny the great improvement which has taken place in the mental and moral qualities of the dog, when we compare him with the wolves and jackals from which he is descended. He has won for himself a tribute of praise from some of our noblest poets; a tribute richly due to his devoted love and fidelity. Hear Wordsworth's lament:

"Tears were shed.
Both man and woman wept when thou wert dead;
Not only for a thousand thoughts that were
Old household words in which thou hadst thy share,
But for some precious boons vouchsafed to thee,
Found scarcely anywhere in like degree.
For love that comes to all, the holy sense,
Best gift of God, in thee was most intense;
A chain of heart, a feeling of the mind,
A tender sympathy which did thee bind,
Not only to us men but to thy kind:
Yea for thy fellow brutes in thee we saw,
The soul of love."

And Byron writes not less warmly:

"The poor dog, in life the firmest friend;
The first to welcome, foremost to defend,

Wnose honest heart is still his master's own,
Who labors, fights, lives, breathes for him alone,
Unhonored falls, unnoticed all his worth,
Denied in heaven *the soul he held on earth.*"

There can be little doubt that if other animals had been valued for their moral qualities, had these been carefully developed from generation to generation, they would have shown a like, or a greater improvement. The intellectual qualities shown by trained elephants, which in their youth have roamed wild through the forests, is so marvellous, that it is difficult to imagine or estimate what intelligence of the race might become after a few generations of cultivation. And the same remark applies to the acuteness of intellect shown in captivity by many apes and monkeys, which have been brought fresh from their native woods. What progress would creatures so intelligent, so teachable, so insatiably curious and so persevering make after a few generations of culture?

But putting aside the great development in the psychology of the dog, we have in paleontology the most unanswerable evidence of the vast improvement which has taken place in the *brains* of mammals since Eocene times.

In our own day the brains of the higher mammals show a great increase in the cerebrum, the part of the brain concerned especially with intellectual functions and its surface is greatly increased by convolutions. Gradually as we go back in geological time the cerebral hemispheres are smaller, then they no longer cover the mid-brain, and the latter shows distinctly, as in reptiles and fishes there are of course no convolutions, and finally in the Eocene we meet with mammals, immense in size, but with the brains of reptiles.[1]

A faulty nomenclature has probably had a great deal to answer for in the tardy recognition of the intellectual powers of the lower animals. Ideas have been divided into "simple" and "general," or into "concrete" and "abstract." It was impossible to deny the existence of simple ideas in brutes, but it was, and is, contended that they are incapable of abstract ideas. Mr. Romanes points out the existence of a wide territory between simple and abstract ideas, and he proposes a

[1]Origin of the Fittest. Cope.

threefold definition of ideas to which he gives several names. It will make the question clearer if we take three of these names and speak of simple, complex and abstract ideas; or of percepts, recepts and concepts.

This definition can be illustrated by taking the word "star." The recognition of one particular star is a simple idea or precept; the recognition of a number of stars, or of bright twinkling objects resembling the shining of stars, is a complex idea or recept. So far the mind of the higher brutes keeps pace with the developing mind of man. But the next step carries us beyond the mental powers both of infants and of animals: neither can conceive the idea of a star as present to the mind of an astronomer. This is an abstract idea or concept, and is unattainable except through the medium of articulate language. Where the child sees a twinkling spark, the astronomer is conscious of a flaming sun; where, until lately, men recognized the symbol of unchangeableness, the astronomer knows he beholds stupendous worlds rushing through space at unimaginable speed; where the Hebrew seer beheld "lesser lights" stuck in a solid firmament solely for the service of man, the astronomer knows that his eye beholds objects at a distance of millions upon millions of miles, objects whose grandeur throws our whole solar system into insignificance. An abstract idea is in itself capable of containing a volume of knowledge; its capacities have hardly any limits but that of the mind itself. Think only of the world of concepts contained in the words "political economy," "vertebrata," "liberty," "Aryan Race," "mythology," "ethics," and we see how far civilized man has outstripped, not only the lower animals, but the young of his own race and the savage; but *the break is not at the minds of the lower animals.* Rather there is no break, but a gradual evolution.

We may take as another instance of simple, complex and abstract ideas the idea of one particular dog in the mind of the child; the idea of dogs in general, extended to figures or pictures of dogs; and the ideas of the genus "Canis" as present to the mind of the zoologist. The first and second conceptions are common to the young child and the lower ani-

mals; the third transcends the power of either. The extension of simple ideas was amazingly illustrated by a little French child, who was warned not to touch fire and candles by the words "Ça brule." This idea she spontaneously applied to other shining objects. Her mother and nurse also amused her by hiding and saying "Coucou." Watching the sun set one evening the child generalized the ideas of shining, burning and of hiding, by exclaiming "Ça brule coucou." A terrier has a very simple idea as to a rabbit; to catch it and kill it anyhow and anywhere. But he also has a general idea of rabbits, as may be demonstrated by calling his attention to this idea if he is out for a walk, when a violent scampering, barking and digging for imaginary rabbits may be expected to take place. A dog formerly in the possession of the Archbishop of Canterbury had the habit of hunting pigs, and for inscrutable reason, always after prayers. After a time there were no more pigs to be hunted in the flesh, but at the word "pigs," the dog vehemently hunted imaginary pigs.

Finally it was enough to open the door, without uttering a word, and the dog rushed to his visionary pig hunt. A dog belonging to Mr. Romanes' sister showed that it not only had an idea of men and women, but that it could recognize that which was like a human being and yet was *not* one. This dog showed the utmost terror at the appearance of three life-sized pictures. But instead of attacking them with tail erect, as he would have attacked a strange person, he "barked violently and incessantly at some distance from the paintings, with tail down and body elongated, sometimes bolting under the chairs and sofas in the extremity of his fear, and continued barking from there." When the faces of the pictures were covered he became quiet and contented, but resumed his frightened barking if one was uncovered. Gradually he became accustomed to the pictures, and after a time he was taken away from the house for some months. On returning, he was again much startled at seeing the pictures, and rushed at them barking. Very quickly though he appears to have reasoned that he had seen these strange things—that were and were not—men and women, before, and that they had proved

harmless, for "after three or four barks he ran back to me "with the same apologetic manner he has when he has barked "at a well-known friend by mistake."[1]

If we arbitrarily confine the definition of "reason" to the power of putting our ideas into *words*, then of course animals must be denied the faculty of reason as they do not possess that of articulate speech. But if to "reason" be to form ideas in the mind; to class them together; to be influenced by them; to act upon them, then animals possess reason. And the extent of reasoning faculty depends upon the development of the brain; on its comparative richness in convolutions, and on its cultivation by education in animals as well as in men. The difference in degree is enormous, but differences in degree do not destroy homologies in zoological classification. An elephant's nose is still a nose though it is prodigiously elongated, and serves as a tactile and prehensile organ. It is not that man has one particular organ highly specialized; immense numbers of animals have organs highly specialized; the foot of the horse; the fore limbs of the bat; the whole skeleton of the whale are conspicuous instances. In man the specialization has been in the brain, and this has made him the master of creation, but the difference between the brain of man and of apes is not so great as the difference between the foot of the horse and that of the elephant. Yet the difference being not between foot and foot, but in the very organ of thought itself, the effect is incalculable in producing superiority of the one animal over the other.

It has been asserted that we can form no general ideas without words. It is true that we so commonly put our ideas into words, that we may be tempted to identify the one with the other. But deaf mutes who have been educated have related their mental experiences when untrained, and they describe themselves as "thinking in pictures." I have had a similar experience in meeting with two plants in the forest of British Columbia; one attaining almost to the dimensions of a forest tree; the other no larger than our wood anemone, yet agreeing exactly in the botanical peculiarity of their

[1]Romanes, Animal Intelligence, p. 456.

flowers. I know now that these plants belong to the genus Cornus, but I did not ascertain this fact for many months, and in the mean time I thought of these plants *in pictures* in which I was vividly conscious of their peculiarities. And where the mind is unable to avail itself of articulate language, this faculty of thinking in pictures may be carried to a point far beyond what we may imagine credible; just as the tying of knots in strings in a particular fashion served as whole books of history to the Peruvian Indians who were unacquainted with writing.

Moreover though unable themselves to employ articulate language, the higher animals have the mental advantage of being able to understand and remember spoken words.

It is estimated that the more intelligent elephants in government employ in India and Ceylon understand more than eighty words and phrases addressed to them by their keepers. This statement is the more credible when we consider the diversity of occupations in which trained elephants are engaged. The most striking instance I know of bearing on the reasoning powers of these sagacious animals is given in Mr. Romanes' work on Animal Intelligence,[1] on the authority of Mr. Bingley.

"In the last war in India a young elephant received a violent wound in its head, the pain of which rendered it so frantic and ungovernable that it was found impossible to persuade the animal to have the part dressed. Whenever any one approached, it ran off with fury, and would suffer no person to come within several yards of it. The man who had care of it at length hit upon a contrivance for securing it. *By a few words and signs* he gave the mother of the animal sufficient intelligence of what was wanted; the sensible creature immediately seized her young one with her trunk, and held it firmly down, though groaning with agony, while the surgeon completely dressed the wound; and she continued to perform this service until the animal was perfectly recovered." When we consider the passionate devotion of the female elephant to her young one, and the fury with

[1]Animal Intelligence. International Scientific Series, p. 399.

which she will defend it from injury or danger, it is almost impossible to admire too highly, the reasoning powers, the self-control, and the intelligent comprehension of words by this mother, under circumstances which would severely try all these qualities in a human parent. It is well-known that elephants patiently, and even gratefully endure painful operations performed on their own persons, such as the cutting open and dressing of deep ulcers, and the dropping of nitric acid in the eye. Yet the same animal would deeply resent the slightest intentional injury, such as the prick of a pin, and would lose no opportunity of revenge.

The account of the extraordinary intelligence shown by the trained elephant "Siribeddi" in the capture of wild elephants, is too long to be given here but will richly repay perusal. [Animal Intelligence, p. 402]. Her comprehension of everything required of her; her original ideas of what should be done on the spur of the moment; her intense enjoyment of the sport; her Delilah-like duplicity towards her male captives; her extreme care to avoid injuring the prisoners; all show an intelligence not below that of a human hunter, whilst in her care to avoid injuring her captives, she puts the human hunter to shame.

In the parrot, low as it is in the psychological scale, compared to the higher mammals, we have examples of the comprehension of words uttered by the animal itself. Mr. Darwin gives an instance of a parrot belonging to the father of Admiral Sir J. Sullivan, which invariably called certain persons of the household, as well as visitors, by their names. He said "good morning" to everyone at breakfast, and "good night" to each as they left the room at night, and never reversed their salutations. To his master he used to add to the "good morning" a short sentence, never repeated after his master's death. He scolded a parrot which had got out of its cage and was eating apples on the kitchen table, calling it "you naughty Polly." Similar instances of the proper application of spoken words could be indefinitely multiplied, but I will only quote the account given by Dr. Samuel Wilkes

F. R. S. of his own parrot, which he carefully observed.[1] He says that when alone this bird used to "utter a long catalogue of its sayings, more especially if it heard talking in the distance, as if wishing to join in the conversation, but at other times a particular word or phrase is only spoken when suggested by a person or object. Thus, certain friends who have addressed this bird frequently by some peculiar expression, or the whistling of an air, will always be welcomed by the same words or tune, and as regards myself, when I enter the house—for my foot-step is recognized—the bird will repeat one of my sayings. My coachman coming for orders has so often been told 'half-past two,' that no sooner does he come to the door than Poll exclaims 'half past two!' Having found her awake at night I have said 'go to sleep' and now if I approach the cage after dark the same words are repeated. Then as regards objects, *if certain words have been spoken in connection with them, these are ever after associated together.* for example, at dinner time the parrot, having been accustomed to have savory morsels given to her, I taught her to say 'give me a bit.' This she now constantly repeats, but only and appropriately at dinner time. The bird associates the expression with something to eat. Again being very fond of cheese, she easily picked up the word, and always asks for cheese at the end of the dinner course, and at no other time. She is also fond of nuts, and when these are on the table she utters a peculiar squeak: this she has not been taught, but it is Poll's own name for nuts for the sound is never heard until the fruit is in sight. Some noises which she utters have been obtained from the objects themselves, as that of a corkscrew at the sight of a bottle of wine, or the noise of water poured into a tumbler, on seeing a bottle of water. The passage of the servant down the hall to open the hall door, suggests a noise of moving hinges, followed by a loud whistle for a cab."

No animal hitherto under observation in England, has shown a more remarkable comprehension of spoken words than the Chimpanzee lately in the Zoological Gardens,

[1]Romanes, Mental Evolution in Man, p. 131.

London. This ape learned from her keeper so many words and phrases, that in this respect she resembled a child shortly before it begins to speak. Moreover it was not only particular words and phrases which she thus learnt to understand, but, to a large extent, "she understands the combination of these words and phrases into sentences, so that the keeper is able to explain to the animal what it is he expects her to do. For example she will push a straw through any particular mesh in the net-work of her cage which he indicates by such phrases as 'the one nearest your foot: now the one next the key-hole; now the one above the bar,' etc., etc. Of course there is no pointing to the places thus verbally designated, nor is any order observed in the designation. The animal understands what is meant by the words alone, and this even when a particular mesh is named by the keeper remarking to her the accident of its having a piece of straw already attached to it." This Chimpanzee could also count correctly as far as five. She was asked for two straws, five straws, one straw, etc., no order being observed in the requests. If she were asked for four straws she successively picked up three straws and put them in her mouth, then she picked up the fourth and handed over all the four together; the ape having been taught, if more than one straw were asked for, to hold the others in her mouth until the sum was completed.

The Crow is little behind the Chimpanzee in arithmetical genius if Monsieur Leroy Ranger at Versailles is to be trusted, and as his life-work consisted in watching the wild and tame animals of the royal domain, he was hardly likely to be deceived. He says "crows will not return to their nests dur-day-light, if they see anyone waiting to shoot them. If to lull suspicion a hut is made below the rookery, and a man conceals himself in it with a gun, he waits in vain if the bird has ever before been shot at in a similar manner. She knows that fire will issue from the cave into which she saw the man enter. To deceive these suspicious birds, the plan was hit upon of sending two men into the watch-house, one of whom passed on, whilst the other remained. But the crow counted and kept her distance. The next day three went,

and again she perceived that only two returned. In fine it was found necessary to send five or six men to the watch-house, in order to put her out of her calculations." The ape and the crow here contrast advantageously with savages who can only count up to one and two, and with the Dammaras who apparently can count only one. In buying sheep from a Dammara one must pay for each sheep separately, for if a stick of tobacco is the price agreed on for a sheep, it would sorely puzzle the simple savage to take two sheep and give him two sticks.[1] One stick must be paid for each sheep separately.

Of the intelligence of the special friend of man in the understanding of spoken words innumerable instances could be given, and many will, no doubt, recur to the mind of any person who has ever owned or watched a dog. Hogg the "Ettrick Shepherd" had a collie who understood most things his master said to him. On one occasion Hogg observed in the most natural tone possible. "I'm thinking the cow's in the potatoes." Immediately the dog, which had been lying half asleep on the floor, jumped up, ran into the potato field, round the house, and up the roof to take a survey; but finding no cow in the potatoes, lay down again. Some little time afterwards his master said in a tone of conviction: "I'm sure the cow's in the potatoes," when the same scene was repeated. But on trying it a third time, the dog only wagged its tail. I had a rough terrier named "Butts" which had, like most dogs, a horror of a bath. If the fatal words "Butts must be washed," or "Butts must have a bath" were uttered in his presence, he would like the "Snark" slowly and silently vanish away, and would be found—if found at all—cowering under the remotest of beds, trembling with apprehension.[2]

From the comprehension of spoken words, (with their imita-

[1]Galton. Tropical South Africa.

[2]I have lately had the privilege of making the acquaintance of a dog called "Peter," who undoubtedly understands spoken words, and not only special tones. Certain words uttered by complete strangers to Peter result in his performance of certain actions, such as " dying for his Queen, fetching slippers, shutting the door, walking and jumping through a hoop, etc., etc. The dog's whole face is quivering with intelligent excitement when he is spoken to.

tive use by parrots) we come to the question of the *origin* of language. Did it spring from the human mind, ready equipped for all uses, like Minerva from the brain of Jove? Or was its origin as simple and as humble, as evolution has shown the early beginnings of other things to be?

In studying the evidence for mental evolution supplied by language, it is essential to begin with the most primitive forms known to us. Instead therefore of having recourse to Sanskrit and kindred Aryan languages, the product of the mental processes of the highest race of man, we must examine the forms of speech of primitive people, and of semi-civilized and savage tribes. Here again ontogeny may take us further and deeper than phylogeny, and problems which have puzzled the learned may find their solution in the nursery.

The dawning wishes and desires of an infant are expressed by indeterminate movements of the legs and arms. A vigorous kicking of the legs will express the joy of a healthy baby at being taken from a place of which it is tired to a fresh room, or out-of-doors. Perhaps the first determinate movement that can be noticed is the forward movement of the arms with the hope of being taken by father, mother, or nurse, and the next, the stretching out of the hands for some coveted object, both occurring very early in a healthy baby. The frustration of these desires, as most of us know to our cost, is accompanied by most piercing vocal demonstrations indicating pain, anger, or disappointment. I cannot help regarding these vocal demonstrations as survivals from the mode of expressing himself "*Homo alalus.*" And if Miocene man roared and screamed as lustily in proportion to *his* size, as does our modern baby, the din must have been truly appalling, and calculated to strike terror into the heart of the Mastodon himself.

(*To be continued.*)

THE UNIONIDÆ OF SPOON RIVER, FULTON COUNTY, ILLINOIS.

By W. S. Strode, M. D.[1]

This report or review of the Unionidæ of Fulton County, Illinois, is based mainly on researches made on Spoon River, a tributary of the Illinois and at a point about twenty miles from its mouth. It is a sinuous, winding stream, something over 100 miles long and with a width varying from 100 to 150 feet. The valley through which it courses averages about one mile in width. In many places cultivated fields come up to the very banks of the stream, and then alternate with strips of timber, or a fringe four or five rods wide of willow, silver maple or elm, is left by the thrifty farmer to protect and hold the banks. Occasionally a great white-armed sycamore is still to be seen, a veritable giant left standing as a memento of the great forest that once filled all this beautiful valley.

The bed and banks of the stream present a variety of conditions suitable to the tastes and habits of a large number of the Unionidæ.

Deposits of black mud, or of mud and clay, sand-banks, and long stretches of rocky or pebbly bottom covered with a sufficient deposit of mud and sand to afford a burrowing place for the molluscs of the river.

The river is a clear-running spring-fed stream, with but little iron, lime or other corroding substances to damage or disfigure the shells; consequently they grow to a size and attain a beauty of markings and coloration not often excelled in the same species found in other water courses.

My observations have for the most part been confined to a part of the stream lying within four or five miles above and below the village of Bernadotte, and at such odd times and moments as a busy practitioner could spare from a large country practice. Provided with a bag or basket, and attired in gum boots reaching to the hips, a hurried run would be

[1]Bernadotte, Ill.

made to the beds of mussels a half mile or more above or below the mill-dam and in an hour's time a bushel or two of specimens would be taken, the collection perhaps representing fifteen to twenty species.

Unio rectus Lamarck.

Not abundant, and fine young shells not often found; both the white and purple nacre specimens are found. Shells seven to seven and a half inches in length are met with.

U. gibbosus Barnes.

Adult shells are common at a locality a mile below the village. Young uneroded specimens harder to obtain, nacre both liver colored and white and occasionally one is found with the shadings beautifully intermingled in the central parts, and with a marginal band of deep purple.

U. anodontoides Lea.

Common; found everywhere associated in small groups or singly. Not a hundred yards of bank can anywhere be found, where there is not more or less of the younger shells, which have been carried out by the muskrats or minks and from which a meal has been obtained from their juicy contents.

It would be interesting to know why Lea gave this handsome species its peculiar name, for it is as unlike an Anodonta as it well could be. The large old specimens are a rich horn color, while younger shells are almost white, and some beautifully rayed with greenish lines. These three allied species maintain characteristics and markings entirely distinct from each other.

U. plicata LeSueur.

Very numerous; wagon loads of them are taken out every season by fishermen to bait trout lines; bushels of them are carried away, and after the epidermis is removed by ashes water, they are utilized in the cemeteries for grave decorations; they are also much used as an edging to flower beds, and walks. A score of years ago, rings made of this shell were in considerable demand and some village geniuses worked up quite a paying industry in their manufacture. A piece of the shell would be worked down by grinding, and the use of drills,

round files, etc., a bit of the sky-tinted edge would be worked into a set, and this would sometimes be further enriched by the addition of a silver moon and stars, making a very pretty and unique ornament that would readily bring the maker one or two dollars.

U. multiplicatus Lea.

This species seems to me to be identical with *U. undulatus* Barnes, and *U. heros* Say. It is not common in Spoon river, but grows to an extraordinary size. Specimens have been taken eight and a half inches long, and weighing several pounds. It is indeed a hero in size.

U. ligamentinus Lamarck.

A numerous species, and growing very large; nacre always a pearly white in this locality. Some shells received from Wisconsin show a pink-tinted nacre. From a shell of this Unio, I took a year ago, one of the finest pearls that I have ever seen, a perfect oval, as large as a small white bean.

U. occidens Lea.

Quite common, and the handsomest Unio in Illinois; no two are alike, there being as great a variety in their markings as there are shells. About one in ten is of the rare pink variety, as beautiful as any sea-shell. The occidens like the anodontoides is a great traveler, and I have tracked them for hundreds of feet in shallow water before coming up to them.

U. ventricosus Barnes.

This species is probably a synonym of the preceding, at any rate if they are two distinct species they shade so interminably into each other that I do not know where to draw the line separating them. The large *U. ventricosus* is probably the male of occidens.

U. capax Green.

Several specimens that I have sent out as occidens, have been pronounced by competent conchologists as the above species. But as yet I doubt the correctness of their diagnosis and do not believe the true capax is to be found in Spoon river.

U. luteolus Lamarck.

This almost universally distributed species, is not without its representation in the rivers of Illinois.

U. tuberculatus Barnes.

Very common and fine; growing to a length of six and a half to seven inches. A characteristic species, totally unlike any other Unio. Found in many parts of the United States, and in all waters and localities maintaining its distinct individuality. In northern waters, nacre white. In the far south a few specimens are found in which it is purple.

U. alatus Say.

Not numerous, but found sparingly all along the river. One was found two years ago, nine inches long.

U. lævissimus Lea.

Very plentiful and fine; a beautiful glossy epidermis and purple nacre.

U. gracilis Barnes.

Quite common in certain localities; grows quite large, but the older shells show much erosion and are apt to be indented or otherwise injured. This Unio and the two preceding it, are a family group, and present many characteristics in common.

U. verrucosus Barnes.

Not common, but a few fine large ones are found, always presenting the peculiar liver colored nacre of this species. The young ones I have not yet met with. Have received this shell from Iowa under the name of *U. graniferus* Lea.

U. pustulosus Lea.

One of the most numerous of all the unios found in Illinois. In Spoon river all sizes from the small young shells to the largest adults are easily found.

U. pustulotus Lea.

Not so common as the preceding but distinguished from it by the lesser number and larger size of the pustule.

U. lacrymosus Lea. Synonym *asperrimus* Lea.

Plentiful, and beautifully marked; does not grow so large in Spoon river, as in the rivers of Indiana; some shells

received from White river being fully twice as large as any found in Illinois.

U. fragosus Conrad.

Not common. It is closely allied to *U. lacrymosus* Lea.

U. metanever Rafinesque.

Not uncommon in some localities and a characteristic species.

U. cornutus Barnes.

A unique species. I know of no locality in Illinois where it can be found in abundance. After a season's searching on the "Spoon" I am not rewarded with over twelve or fifteen, but these present such a variety of coloring of from green to red, and so odd in character with their knob or horn-like projections that each find is welcomed as a prize.

U. ebeneus Lea.

A few found in the Spoon; more common in the Illinois near Pekin.

U. elegans Lea.

This fine shell does not belie its name; it is truly an elegant Unio; found associated with the next species to which it is related.

U. donaciformis Lea. Synonym *zigzag* Lea.

Far more common than the elegant. A very handsome pink variety is found in Spoon river.

U. trigonus Lea.

A very common mollusc found everywhere on the Spoon; easily distinguished by its velvety epidermis and the red meat of the animal.

U. obliquus Lamarck.

Rare.

U. orbiculatus Hild.

A few found. A doubtful species.

U. parvus Barnes.

Common above the dam in deep water.

U. ellipsis Lea.

Rare.

U. solidus Lea.
Rare.

U. subovatus Lea.
Not common.

U. wardii Lea.
Not common.

Margaritana complanata Barnes.
Quite common, and the largest Margaritana.

M. rugosa Barnes.
Common, large and fine; salmon colored nacre.

M. marginata Say.
A few found in the Spoon.

M. hildrethiana Lea.
Have found them only in one locality on the Spoon. A half mile below the village of Bernadotte where a great ledge of rocks, juts out over the river; here at low tide the muskrats carry them to the flat top of a rock; and in no other place have I been able to find them.

M. calceola Lea.
A few in the Spoon, more common in the Illinois.

M. confragosa Say.
Rare.

Anodonta grandis Say.
Truly a grand species; specimens six to seven inches long have been taken. More common above the dam in deep water.

A. decora Lea.
More common in the Spoon than the preceding, and much more fragile.

A. plana Lea.
A fine shell; groups with the preceding, but much less common.

A. edentula Say.
Many in Spoon river, quite variable in coloration.

A. imbecilis Say.

Common near the " Big Rocks " a half mile down the river. Not so large as specimens received from other localities, but epidermis a more brilliant green.

A. corpulenta Cooper.

A. suborbiculata Say.

Two characteristic and beautiful Anodons, found in a lake near the mouth of Spoon river. The *A. suborbiculata* Say, is a fine yellow, waxy looking shell, and does not seem to be in any way related to any other Anodon.

I also found in this lake a variety of *U. anodontoides* but half the size of those found in Spoon river, and differing from it somewhat in shape.

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WOODWARD, A. S.—Note on the Occurrence of the Saiga Antelope in the Pleistocene Deposits of the Thames Valley. Ext. Proceeds. London Zool. Soc., Nov. 4, 1890.

——Evidence of the Occurrence of Pterosaurians and Pleiosaurians in the Cretaceous of Brazil, discovered by Joseph Mawson, Esq., F. G. S. Ext. Ann. and Mag. Nat. Hist., Oct., 1891.

——Microsaurian from the Coal; Memoir of William Davis, F. G. S. Ext. Geol. Mag., Decade III, Vol. VIII, 1891. From the author.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Fresh-Water Diatomaceous Deposit from Staked Plains, Texas.—Some nearly white earth, very light in weight, from Crosby County, Texas, and within the Staked Plains region was submitted by Prof. E. D. Cope to the first of the undersigned authors for examination.

In a contribution to the "Vertebrate Paleontology of Texas," page 123 of the Proceedings of the American Philosophical Society, Prof. Cope states that this material is from the Blanco Cañon beds as named by Mr. Cummins in the first annual report of the Geological Survey of Texas, 1890, page 190, and describes it as a "white siliceous friable chalk."

Under the microscope this earth is found to be constituted almost entirely of the siliceous skeletal remains of fresh-water diatoms, probably 90 per cent. of the body of the earth being made up of these minute single celled forms of plant life. The mass was disintegrated and the diatoms separated and cleaned by J. A. Shulze after which the forms were referred to C. Henry Kain for identification which he has done with much care and after consultation with various authorities, both by personal letter and through the medium of their publications.

He reports: "This is a fresh-water fossil deposit. The species contained in it may now be found living in Utah and in the Yellowstone Park. Many of the species are also common to fresh water streams everywhere."

The following number of species, twenty-seven in number, though not exhaustive, is nearly so.

Amphora ovalis Ehr.; *Amphora uncinatum* Ehr.[1]; *Achnanthes ventricosa* Ehr.; *Campylodiscus clypeus* Ehr.[2]; *Cymbella cistula* Hempr.;

[1]This is doubtless the form which Ehrenberg figures as *Cocconema uncinatum*—see Proc. Roy. Acad. Berlin, 1870, pl. 1 (II) fig. 9. It is however really an *Amphora*.

[2]In a preliminary list furnished by C. H. Kain, and published by Prof. E. D. Cope in the paper before referred to (see page 123) this form is noted as *C. bicostatus*, having been wrongly identified before the cleaning of the material rendered the markings plainly visible.

Cymbella lanceolatum Ehr.; *Denticula valida* Pediceno; *Epithemia gibba* (Ehr.), Kutz; *Epithemia gibba* var. *parallela* Grim; *Epithemia zebra* Ehr., Kutz; *Epithemia gibberula* (Ehr.), Kutz var. *producta* Grim; *Epithemia constricta* Breb; *Encyonema ventricosum* Kutz; *Gomphonema clavatum* Ehr.; *Fragillaria virescens* Ralfs.; *Navicula major* Kutz; *Navicula viridis* Kutz; *Navicula rostrata* Ehr. *forma minor; Navicula bohemica* Ehr.; *Navicula elliptica* var. *minutissum* Grim; *Navicula decurrens; Navicula varians* Greg.; *Navicula brebissonii* Kutz; *Navicula forma* Kutz; *Nitzschia brebissonia* Wsm.; *Nitzschia spectabilis* (Ehr.), Ralfs.; *Surrirella geroltii* var.—Lewis Woolman and C. Henry Kain.

In the paper previously referred to Prof. Cope notes the occurrence in this diatomaceous stratum of a "Mastodon of the angustidens type" and of a horse allied to the *Equus ocidentalis* of Leidy, and defines the latter as a new species to which he assigns the name *Equus simplicidens;* and indicates by a comparison of Equus and Mastodon fauna that the age of the Blanco Cañon beds is probably intermediate between that of the Equus beds and the Loup Fork beds or the equivalent of the pliocene proper.

In view of this determination of the age of these beds the close correspondence of all the specific forms of diatoms above listed becomes interesting as showing the wide geological range for the forms of these low organisms.

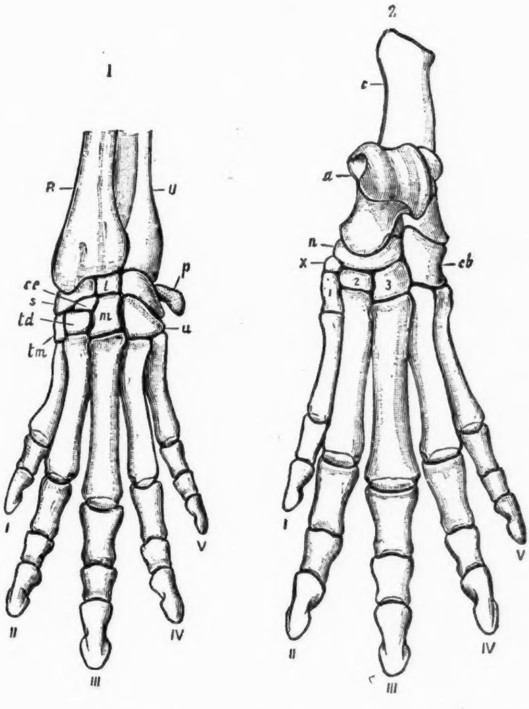
Is Meniscotherium a Member of the Chalicotheriodea ?—The description of the complete foot structure of *Meniscotherium* or *Hyracops* by Marsh[1] tends to confirm the supposition I advanced in the Naturalist of October, 1891. At the time, I stated that the structure of the skull and teeth of *Meniscotherium* pointed to a striking similarity between this Wahsatch genus and the Miocene *Chalicotherium,* but that the question would turn upon the foot structure of the earlier form.

I reproduce here, side by side, for purposes of comparison, the fore and hind feet of *Meniscotherium* (Hyracops) *sociale* Marsh, and of *Chalicotherium,* from the figures of Gervais.

It will be seen at once that both are essentially tridactyl types. In *Meniscotherium* the three middle digits are greatly enlarged while the outer digits I and V are equally reduced in both the manus and pes, indicating that the feet are well established upon the tridactyl basis. Marsh describes the ungual phalanges, as intermediate between hoofs

[1]Am. Journ. Science, May, 1892, p. 447.

and claws. "Their extremities are thin, somewhat expanded, and more like those of primates than of any other group. They were apparently covered by thin nails." There is no displacement but the



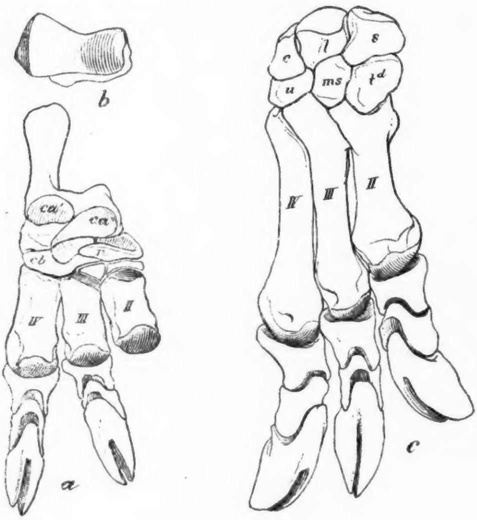
Fore and Hind Feet of Meniscotherium after Marsh.

carpals and tarsals are serial and there does not seem to be even any metapodial displacement. The inference is that *Meniscotherium* was, unlike *Chalicotherium*, a semi-plantigrade.

Many marked differences should also be noted. As I pointed out in comparing the limbs of *Chalicotherium* with those of *Palaeosyops*, the displacement in the former is exactly similar to that in the Perissodactyla. We also note the extremely short neck of the astragalus in *Chalicotherium* as contrasted with the long slender neck of *Meniscotherium*. There is also a great transformation in the claws. Most of

these differences may have been bridged over in the long period intervening between the Wahsatch and the Miocene. We find cases of a similar transformation in other lines both in the reduction of the lateral toes and in the displacement. The characters which unite and separate these forms may be summed up as follows:

MENISCOTHERIUM.	CHALICOTHERIUM.
Tridactyl (functionally)	Tridactyl (structurally).
Main axis through third digit	Main axis through fourth digit.
Sub-ungulate	Unguiculate.
Carpals and tarsals serial	Carpals and tarsals displaced as in Perissodactyla.
Centrale and (tibiale)	Wanting.
A fibulo-calcaneal facet	None.
Anterior portion of dental series reduced	Same reduced or wanting.
Superior molar buno-selenodont	Superior molars buno-selenodout.
Metaconid reduplicate	Metaconid reduplicate.
A mesostyle	A mesostyle.



Fore and Hind Feet of Chalicotherium after Gervais.

No third lobe on last lower molar...No third lobe on last lower molar.
Hypocone and metaconule united
in short transverse crest............Hypocone and metaconule united
in a short transverse crest.

Altogether, the resemblances between these two forms are fundamental, the differences are mainly such as separate many lower Eocene from middle Miocene forms. Although no intermediate forms are known, there is a presumption in favor of a genetic relationship. At all events *Meniscotherium* will probably be removed from the Condylarthra, where it has always held an anomalous position and be placed in the Chalicotheriodea.—HENRY F. OSBORN, American Museum of Natural History. May 3rd, 1892.

Geological News.—General.—In a preliminary paper on the Ouachita Mountain System in Indian Territory, Mr. Robt. T. Hill remarks that these mountains should no longer be omitted from our maps, for they constitute the foundation of all later geologic structure in the Texas region, differentiating it from the Kansas-Missouri region in both present and past geologic times back to the earlier Mesozoic epochs, and influencing all the main river courses of Indian Territory whose great southward bends are an adaptation to the strike of this mountain system, the Washita alone having cut through it. (Am. Journ. Sci., Aug., 1891).——**Paleozoic.**—Mr. M. E. Wadsworth announces that the recent observation of the "South Trap Range" east of Lake Gogebic in Michigan shows that both the lava flows, and the eastern sandstone dip at a low angle, are one formation, and are as conformable as eruptions of lava can be with a contemporaneous sedimentary deposit. (Am. Journ. Sci., Nov., 1891).——**Cenozoic.**—A new species of Moa from New Zealand is announced by Mr. Lydekker, *Pachyornis rothchildi.* The species is founded on the right femur and the two tibio-tarsi and tarso-metatarsi figured and described in the Proceeds. London Zool. Soc., Nov., 1891.——The bird-bones collected by Major Forsyth from the Plistocene beds of Corsica and Sardinia have been referred by Mr. Lydekker to the following families: *Stringes, Acciptres, Picariæ, Passeres, Columbæ, Gallinæ,* and *Turbinares.* (Proceeds. Zool. Soc., London, 1891., p. 467).——Mr. R. D. Salisbury records a series of facts which warrant the conclusion that glaciation extended further southward than the hitherto accepted terminal moraine. The character of this extra-morainic drift indicates that it is probably the equivalent of the oldest glacial drift of the interior. (Bull. Geol. Soc., Am., 1892, p. 173).

MINERALOGY AND PETROGRAPHY.[1]

Quartz and Feldspar Inclusions in Diabase.—Backström[2] has discovered in several Scandinavian diabases inclusions of quartz and feldspar, and has carefully studied the effects produced by the reactions between them and the enclosing rock magma. The diabase consists of labradorite, three augites, magnetite and several secondary substances, and has a structure that differs slightly from the diabasic structure, in that the angles between the plagioclase and the more or less columnar augite, are filled with a groundmass of feldspar laths, pyroxene needles, magnetite and chlorite. Near the quartz inclusions the quantity of the groundmass increases and the diabasic structure becomes obscure, until it finally disappears, and in its place is seen a porphyritic aggregate with thick tabular crystals of plagioclase, well formed augite prisms and large grains of magnetite in a groundmass that occupies a third or a half of the field of view. Very near the quartz the plagioclase become smaller, and spherulites of quartz and feldspar more abundant, of which the latter mineral is either orthoclase or oligoclase. The feldspathic inclusions in the rock are orthoclase, microline and plagioclase. The action of the magma upon the microline is shown in the existence in it of 'solution-spaces,' which are spaces dissolved from the midst of the mineral and afterwards filled with rock magma, from which have crystallized pyrite, magnetite, ilmenite, needles of pyroxene, lath-shaped crystals of oligoclase, grains of quartz, calcite and masses of chlorite. The orthoclase inclusions sometimes become granulated, or filled with long lenticular areas of a feldspar whose origin is the same as that of the minerals in the solution spaces. Plagioclase fragments have also undergone granulation, and the new feldspar has crossed the original twinning planes irrespective of their directions. Other fragments are more completely penetrated by the magma, so that everywhere throughout their mass may be detected small areas of the diabasic groundmass with its spherulites. The peripheries of the grains are often marked by growths of new, colorless, transparent plagioclase, crystallographically continuous with the enclosed mineral. Mica, hornblende and other iron-bearing compounds seem less capable of resisting the action of the

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]Bihang t. k. Svensk. Vet. Akad. Handl., B. 16, Afd. II, No. 1.

magma than the feldspar fragments. They are consequently often entirely dissolved, leaving behind them scarcely a trace of their former existence. When cores of these remain they are surrounded by magnetite, quartz (?) and sometimes newly formed biotite. Before closing his article the author calls attention to the differences in the action of diabasic and basaltic magmas upon enclosed fragments, the most noticeable being that in the former case no glass inclusions are developed in the material of the enclosed substances, while in the latter case these are abundantly formed.

The Basalts of Cassel.—Among the basaltic rocks occurring in the neighborhood of Cassel, Fromm[1] distinguishes limburgites, basalts and nepheline-basalts. All are porphyritic, with olivine, augite and labradorite (in the plagioclastic varieties) as phenocrysts in a groundmass of augite, plagioclase, probably sanidine, magnetite, ilmenite, hematite, mica and apatite in the feldspathic rocks and in the nepheline basalts with a groundmass of much the same character except that nepheline replaces the feldspar. Besides, a little glassy base is always present. Some of the olivine is brecciated as if broken by the movement of the rock in which it occurs. Again it is corroded, when it is often surrounded by a rim of glass, which the author thinks is due to rapid cooling of the dissolved portion of the mineral. The augites are often zonal, with the deeply colored zones within in the plagioclase basalts, and in the nepheline varieties with the lighter colored zones in the interior. The nepheline present in the nepheline basalts is either in the form of a uniformly distributed groundmass in which are imbedded microlites of augite or in little nests between the other minerals, or finally as small areas with crystal cross sections. Mellilite was detected in a nepheline basalt and good plates of pleochroic ilmenite were observed in several plagioclase basalts. Glass was present in the limburgite, in several plagioclase basalts and in one nephelinic variety. Quartz fragments included in the plagioclase basalts are surrounded by rims of augite crystals, between which and the nucleus is often a zone of glass. Sometimes the quartz has entirely disappeared, leaving only glass encircled by a crown of augite. Analyses of all the varieties of the rocks studied accompany the paper.

The Rocks of the Piedmont Plateau.—In an excellent article on the structure of the Piedmont Plateau in Maryland, G. H. Williams[2] divides the region between the Catoctin Mountains and the

[1]Zeits. d. d. Geol. Ges. xliii, p. 43.
[2]Bull. Geol. Soc. Amer., Vol. ii, p. 301.

Costal area into two parts, a Western one underlain by fragmental rocks in which but slight alteration has been effected, and an Eastern one characterized by both sedimentary and eruptive rocks that have been strongly metamorphosed by pressure. In the first area phyllites, including sericite, chlorite and ottrelite schists, sandstones made up of undoubtedly clastic grains, and a few crystalline limestones occur. In the Eastern area the piedmont rocks are gneisses, some of which are evidently eruptive and others probably sedimentary; quartzites and quartzite-schists, in which all evidences of fragmental origin have disappeared, coarse crystalline marbles containing phlogopite, tremolite, scapolite, etc., and acid and basic eruptives. Each of these classes, except those belonging to the eruptive division, is briefly characterized, and pictures[1] of the sandstone of the Western area and of the quartzite of the Eastern area are given for comparison.

The Diorite of the Andes, first mentioned by Stelzner as a characteristic rock of this mountain range, has been closely studied by Möricke[2] in the occurrence at St. Cristobal near Santiago in Chile. It is closely associated with andesites, both hornblendic and augitic, with propylite and tufas, in such a way that the author is led to look upon them all as facies of the same rock mass, the diorite representing the deep-seated phases and the andesites the surface flows. The hornblende, augite and hypersthene-augite, andesites and the diorites have the usual characteristics of these rocks. With respect to structure an intermediate phase occurs in the propylite, which consists of phenocrysts of plagioclase and green hornblende in a ground mass of plagioclase, chlorite and epidote. The propylite is much altered, while the other rocks are fresh. The geological relations of the different rock types correspond with the conclusions outlined as above. The 'stocks' of diorite, often forming the peaks of the range, are the denuded cones of old massifs.

The Porphyry of Monte Doja.—Pelikan[3] has re-examined the rock discovered by Suess at Monte Doja, in the Adamello group of mountains, and described by him as a reddish brown porphyry. The structure is porphyritic and the groundmass is dark brownish red in color. Under the microscope the thin section shows a colorless base containing yellowish-brown wisps of biotite, thin prisms and fine

[1] C. R. Keyes, Ib. p. 321.
[2] Min. u. Petrog. Mitth. xii, p. 143.
[3] Min. u. Petrog. Mitth., xii, p. 156.

needles of rutile and six-sided prisms of tourmaline. The colorless mass in which these are imbedded contains plagioclase, orthoclase and quartz. The porphyritic crystals in this groundmass are cordierite. They all possess a more or less hexagonal cross section, and the usual optical properties of the mineral. Its inclusions are biotite plates and rutile, and tourmaline crystals like those of the groundmass. The composition of the rock is represented by the figures:

SiO_2	TiO_2	Fe_2O_3	Al_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O
56.88		2.66	20.86	4.54	1.29	3.15	7.48	.90	2.36

Corresponding to 18% of cordierite, 20% of mica, 30% of orthoclase and 13% of plagioclase. The origin of the rock is unknown.

Wernerite Rocks occurring at several places in the Pyrenees are stated by Lacroix[1] to be altered feldspathic eruptives. The original form of the varieties from Sallix and Ponzac was a hornblende diabase containing olivine, biotite and sphene. The borders of the feldspar, which is labradorite, are often fringed by little plates of dipyr. Veinlets of these penetrate the plagioclase until in some cases all the labradorite is replaced by large plates of the scapolite, many of which are of much larger size than the feldspars from which they were formed. They moreover possess a uniform orientation over large areas, so that the structure of the rock passes from the microlitic to the granular. When dynamic agencies have modified it broken pieces of the scapolite are often found. This indicates to the author that in these cases the alteration of the feldspar preceded the crushing. On the other hand, broken pieces of all the other minerals are sometimes found cemented by unbroken dipyr, in which case the formation of the latter mineral was subsequent to the shattering. The alteration is thus a strictly chemical process. The paper closes with a reference to the Norwegian scapolite rocks and their comparison wth those of the Pyrenees.

Petrographical News.—The phonolites[2] of Montusclat and of Lardeyrols in the Ardennes, in France, contain small crystals and crystallites of låvenite, the latter often grouped into forms resembling the skeletons of large crystals. The larger crystals are golden yellow, with a strong pleochroism.

[1]Bull. Soc. Franc., d. Min. xiv, p. 16.

[2]Lacroix. Ib., xiv, p. 15.

Anatase and brookite are described[1] as occurring in French rocks, the former in the mica porphyrites of Pranal, Puy-de-Dom, and the latter in the chloritized mica of the limestone of Ville-es-Martin, in the Loire-Inférieure, and in the mica of a mica porphyrite from Pouchon, in Cercie, and in the granite of Lacourt, Ariège.

The same author[2] announces the discovery of octahedra of cristobalite associated with tridymite in a piece of quartz inclusion from the basalt of Mayen in Rhenish Prussia.

Nova Scotian Gmelinite.—A careful analysis of *gmelinite* from the Five Islands, Nova Scotia, has been made by Pirsson,[3] and the properties of the mineral have been investigated. The mineral occurs in seams in a decomposed trap. In thin sections its crystals are found to be composed of a colorless compact outer zone enclosing a flesh-colored, friable inner nucleus. Their habit is short pyramidal, and their axial ratio $a : c = 1 : .7345$. Two methods of twinning were observed, viz., interpenetration twinning with oP the twinning plane, and contact twinning parallel to $\frac{2}{3}$R. The double refraction is weak and negative, with $\omega - \varepsilon$ for sodium light = .0033. Density = 2.037, and composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	H_2O
50.35	18.33	.26	1.01	.15	9.76	20.23

The author regards the mineral as a sodium-chabazite, in which Na : Ca = 8 : 1. The sodium is thought to exert a marked morphotropic action, since the crystallographic planes of the gmelinite cannot be conveniently referred to the axes of chabazite. It may, therefore, be considered as a distinct mineral species.

Crystallography of Cerussite, etc.—Pirsson[4] also contributes a few crystallographic notes on *cerussite, gypsum* and *krämmerite.* Twinned crystals of the first-named mineral from the Red Cloud Mine, Ariz., are arrow-shaped, with the plane $\infty P\breve{3}$ the twinning plane. The gypsums are from Girgenti, Sicily. They are twinned according to the usual law, but $\frac{1}{3}P\bar{\infty}$ so largely predominates over other forms that they resemble basal planes and cause the twinned crystals to resemble in symmetry an orthorhombic form. The krämmerite studied is from

[1]Lacroix. Ib., xiv p. 191.
[2]Ib., xiv, p. 185.
[3]Amer. Jour. Sci., July, 1891, p. 56.
[4]Amer. Jour. Sci., Nov., 1891, xlii, p. 405.

Texas, Pa., and is the same as that examined by Cooke[1] in 1867. Three new forms were observed on it, viz.: $\infty P2$, $\frac{1}{2}P2$ and $\frac{1}{3}P$. The prism $\frac{1}{2}P2$ is very characteristic and is seldom wanting. The author also corrects the axial ratio for *mordenite* to $a : b : c = .401 : 1 : .4279$. $\beta = 88° 29' 46''$, and briefly describes skeleton crystals of *hematite* from Durango, Mex., filled with cassiterite and pseudomorphs of the latter mineral after the former.

Mineralogical News.—Dr. Hoffman[2] mentions a quartzite from the North shore of St. Joseph Island, in Lake Huron, whose joint planes are coated with limonite containing numerous tiny spherules composed of a nucleus of silica, coated with a humus-like substance, which in turn is overlain by a layer of metallic iron. The spherules form 58.85% of the mixture. They have a density of 6.8612 and the following composition: Fe = 88.00; Mn = .51; Ni = .10; Co = .21; Cu = .09; S = .12; P = .96; C = ?; insol. res. = 9.76. The insoluble residue consisted of little concentric bodies with the composition: $SiO_2 = 93.95$; $Al_2O_3 = 1.13$; $Fe_2O_3 = 1.02$; CaO = .62; Mg = .31; Loss = 2.97.

Analyses of uraninite from two new localities are given in a recent paper by Hillebrand[3]. The first is that of a specimen obtained from Marietta, Greenville Co., S. C., and the other that of one from the Villeneuve Mine, Ottawa, Quebec. Neither of the two was pure.

	UO_3	UO_2	ThO_2	ZrO_2	CeO_2	(La. etc.)	Yt. etc.	CaO	PbO	H_2O
S. C.....		83.95	1.65	.20	.19	2.05	6.16	.41	3.58	und.
Que.....	41.06	34.67	6.41	?	.40	1.11	2.57	.39	11.27	1.47

	N	SiO_2	Insol.	Fe_2O_3	X
S. C....................	undet		.20	tr.	tr.
Que....................	.86	.19	.13	.10	.09

Results of the analyses of the same mineral from Llano Co., Texas, and from Johann-georgenstadt, Sax., show the presence of nitrogen in each.

Williams[4] has discovered *anatase* crystals in a jointed slate from five miles South of Bremo Bluffs, Buckingham Co., Va. The crystals are small and are associated with pyrite and quartz, which cover the faces

[1] Ib., 1867, xliv, p. 201.
[2] Amer. Geol., viii, p. 105.
[3] Amer. Jour. Sci., Nov., 1891, p. 391.
[4] Ib., Nov., '91, p. 431.

of the joint cracks. P and oP are the only faces observed on the anatase.——Crystalline masses of *ilvaite* are reported by Hoffman[1] from a twenty-foot vein near the head of Barclay Sound, Vancouver Island, British Columbia. Its hardness is 5.5, density 3.85 and composition:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O
29.81	.16	18.89	32.50	2.22	13.82	.30	1.62

Celestite from Scharfenberg, near Meissen, Saxony, according to Stuber[2] occurs in druses of little blue crystals whose axial ratio is .7807 : 1 : 1.2834, and whose habit is determined by the planes $P\breve{\infty}$, oP and $\frac{1}{2}P\bar{\infty}$. Another druse is made up of brown or wine-yellow crystals whose habit differs from that of the blue crystals in that oP is small. Their axial ratio differs also, since $a : b : c = .7834 : 1 : 1.2962$.

Weed and Pirsson[3] describe orthorhombic crystals of *sulphur* from around the vents at the Highland Hot Springs and at Crater Hills in the Yellowstone National Park, and stalactitic and fibrous growths of orpiment and realgar in crevices of the rock surrounding vents in the Western part of the Morris Geyser Basin in the same territory.

Nesquehonite exists in the anthracite mine of Mure, Isère. Its analysis by Friedel[4] gives results that prove its identity with the nesquehonite of Genth and Penfield.

Syntheses.—While heating mica with soda and sodium sulphate in a tube the mixture became dry, leaving a residue in which the Messrs. Friedel[5] discovered little rhombohedra, with the composition of *nosean*. Upon heating mica, soda and sodium carbonate for two days at 500° the same experimenters obtained little hexagonal pyramids of a substance with the composition $3\ (2\ SiO_2, Al_2O_3, Na_2O) + Na_2\ CO_3 + 2H_2O$, which the authors regard as a calcareous rich cancrinite. If amorphous alumina be heated at 530° in a solution of soda in a closed tube the excess of the first material will separate[6] upon cooling as *corundum*. If heated at 400° *diaspore* is produced. When the soda contains a little aluminum and calcium carbonates, *calcite* crystals

[1] Ib., Nov., '91, p. 432.
[2] Zeits. f. Kryst., xix, 1891, p. 437.
[3] Ib., Nov., 1891, p. 401.
[4] Bull. Soc. Franc. d. Min., xiv, p. 60.
[5] Bull. Soc. Franc. d. Min., xiv, p. 69.
[6] G. Friedel. Ib., xiv, p. 7.

accompany the corundum. These experiments throw some light upon the production of corundum in metamorphosed limestones. Under similar conditions magnesia yields *brucite*. When calcium silicate is treated with sodium borate at high temperatures under pressure *datholite* crystals are formed, according to Wyrouboff.[1]

Miscellaneous.—A new contribution to the discussion of the cause of optical anomalies is from the pen of Karnojitzky[2], who ascribes the phenomena to polymerism. Paramorphic substances are thought to be polymeric, with the higher polymer more stable than the simpler one. The latter usually possesses a higher degree of symmetry than the former, and hence, when it forms first it gives a higher degree of symmetry to its crystals than is possessed by those of its paramorph—the more stable, more complicated compound. The author develops this idea in a very logical and clear manner, and instances many examples to indicate the probability of the correctness of his statements.

Retgers[3] proposes to test the isomorphism of different substances by forming of them mixed crystals, which, if the two substances used be isomorphous, will differ continuously in their physical properties. In the case of colored salts the test most easily applicable is that of color. If potassium chlorate and the corresponding permanganate be dissolved in water and a drop of each be placed in an object glass and allowed to come in contact, the crystals formed at the junction of the two drops will be intermediate in color between those formed at a distance from it. In the case of salts that are not isomorphous no gradation in color will be observed. In his article the author mentions the many compounds that he has discovered to be isomorphous.

Lemberg[4] suggests a modification of micro-chemical analysis by which minerals are detected rather than their constituent elements. For instance, instead of distinguishing between hauyne and sodalite by studying their elements, the author would study the effect of the minerals themselves upon reagents, *e. g.* sodalite will precipitate silver chloride from a weak nitric acid solution of silver nitrate, whereas hauyne will not do so. Chabazite reacts rapidly with ammonium chloride and generates ammonia, while thomsonite, analcite and leucite

[1]Ib., xiv, p. 197.

[2]Zeits. f. Kryst, xix, p. 571.

[3]Zeits. Physik. Chem., viii, July, 1891, p. , and Jour. Chem. Soc., lx, p. 1151, Cf.; also Lehmanne Die Krystallanalyse, p. 57.

[4]Zeits. d. d. Geol. Gesele., xlii, 1891, p. 737.

are without effect upon it of any kind. The principal minerals studied by the author that yield definite and distinctive results are hauyne, sodalite, scapolite, chabazite, calcite, witherite, cerussite and anglesite and others of less importance. The method of manipulation necessary to produce good results is described in each case with great minuteness.

Dufet[1] describes a method for the determination of the comparative values of the indices of refraction by means of the prism and total reflection, and Lavenir[2] gives an account of a new process by which the optical orientation of any crystal may be determined.

A report on "The Mineral Resources of the Province of Quebec," by Ells[3], contains a history of the various mining industries of the district. In the same annual report Hoffmann[4] publishes a list of the minerals occurring in Canada, and Ingalls[5] gives statistics relating to the production and exportation of the mineral products of Canada.

[1]Bull. Soc. Franc. d. Min., xiv, p. 130.

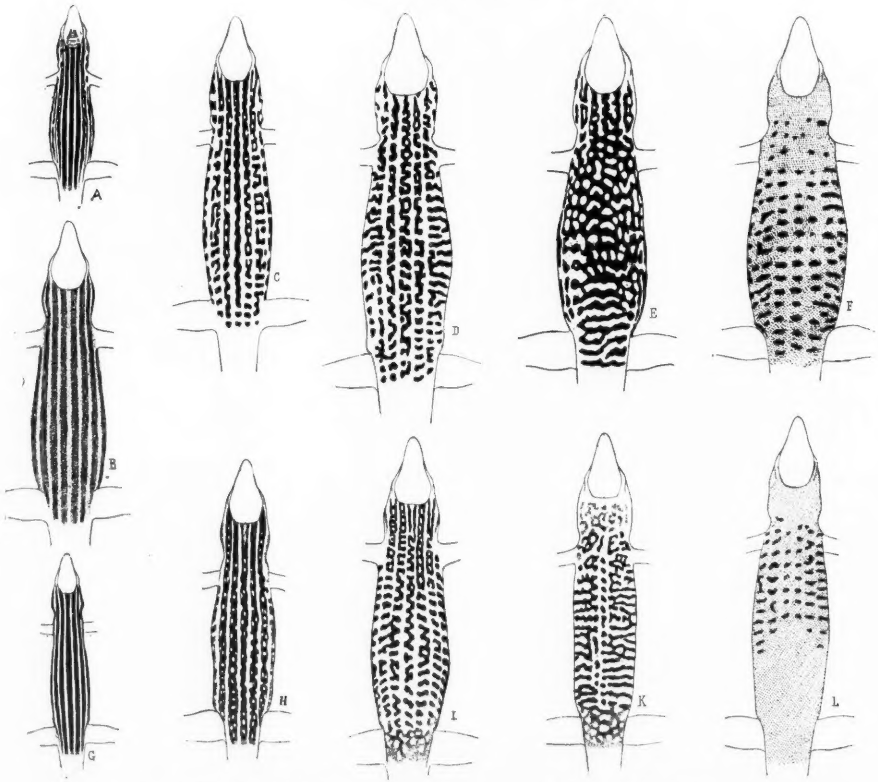
[2]Ib., xiv, p. 100.

[3]Pt. K. Ann. Rep. Can. Geol. Survey, 1888–89.

[4]Pt. I. Ib.

[5]Pt. S. Ib.

PLATE XVIII.



A–F, *Cnemidophorus tessellatus*. G–L, *C. gularis*.

ZOOLOGY.

The Classification of the Anthomedusan Jelly-Fishes.—Dr. Vanhöffen begins his attempt to arrange the Anthomedusæ[1] with severe criticism of the system of Haeckel and then gives that which he would propose to take its place, an outline of which follows here. The reader will notice the almost iconoclastic manner in which Dr. Vanhöffen relegates genera into synonymy.

ANTHOMEDUSÆ.

Craspedote Medusæ with the sexual products in the ectoderm of the stomach [proboscis].

I. CODONIDÆ. Gonads not separate; embracing the proboscis as a continuous ring.

1. SYNCORYNIDÆ (SARSIADÆ). Medusæ produced from Syncoryne and similar polyps, with regular radially developed umbrella, and four well-developed tentacles. Genera: 1, *Sarsia* (including *Codonium* and *Syndiction*), Hydroid, Syncoryne; 2, *Dipurena* (including *Bathycodon*), Hydroid?; 3, *Corynetis*, Hydroid, Halocharis?.

2. PENNARIIDÆ, Medusæ with Pennaria-like hydroid; regularly developed umbrella and four rudimentary tentacles. Genus: *Globiceps*.

3. CORYMORPHIDÆ, Medusæ with Corymorpha-like hydroid; umbrella either radial or more or less irregularly bilateral; tentacles four, two, one or none.—Genera: 1, *Amalthæa*, Hydroid, *Corymorpha*; 2, *Hybocodon* (incl. *Amphicodon*), Hydroid, Corymorpha; 3, *Euphysa* (including *Steenstrupia*), Hydroid?; 4, *Diconodum*, Hydroid?; 5, *Ectopleura*; Hydroid, *Ectopleura*.

II. OCEANIDÆ. Four or fewer pairs of interradial gonads in the ectoderm of the proboscis.

A. Cœlomerintha. Strongly contractile hollow tentacles whose small entoderm cells enclose a large lumen.

4. AMPHINEMIDÆ. With numerous marginal lobes like rudimentary tentacles between fewer well-developed tentacles.—Genus *Stomatoca* (including *Amphinema* and *Codonorchis*).

5. TIARIDÆ. With numerous well-developed tentacles. Young with two (*Dinema*) or more tentacles between which are seen the soli-

[1]Zool. Anz. xiv. p. 439, 1891.

tary rudiments of other tentacles as thickenings of the umbrella margin.—Genera: 1, *Conis*; 2, *Tiara*, Hydroid, *Campaniclava*?; 3, *Turris*, Hydroid, *Clavula*; 4, *Catablema*.

B. **Pycnomerinthia.** Tentacles solid; filled with large entoderm cells.

a. MONERENEMATA. With simple separate tentacles.

6. DENDROCLAVIDÆ. With sessile nematophores on the margin of the mouth—Genus *Turritopsis*, Hydroid, *Dendroclava*.

7. PODOCORYNIDÆ. With short oral tubes and stalked nematophores on the mouth margin—Genera: 1, *Cytæis*; 2, *Thamnitis*; 3, *Cubogaster*; 4, *Dysmorphosa* (including *Cytæandra*), Hydroid, *Podoco ryne*.

8. THAMNOSTOMIDÆ. Oral tube elongate, surpassing the stalked nettle clusters.—Genera, 1, *Thamnostylis*; 2, *Thamnostoma*; 3, *Limnorea*.

β. Lophonemata. Tentacles simple, in bunches.

9. BOUGAINVILLEIDÆ[1]. With stalked nematophores on oral margin.—Genera: 1, *Margelis*; 2, *Hippocrene* (including *Nemopsis*); 3, *Rathkea*.

γ. Cladonemata. With compound, feathered or branched tentacles.

10. PTERONEMIDÆ. Tentacles feathered.—Genera: *Pteronema*; *Ctenaria*; *Zanclea*; *Gemmaria*.

11. DENDRONEMIDÆ. With branched tentacles—Genera: 1, *Cladonema* (including *Dendronema*); 2, *Eleutheria*.

Free-Swimming Sporocysts.[2]—M. Braun has studied "free-swimming sporocysts" similar to those described by Prof. Wright,[3] only larger,—6 mm. long. They are shaped like a T and in the stem of the T a distorted Distomum was visible. Thus these apparently free-swimming sporocysts are enormously developed Cercariæ, closely allied to *C. macrocerca* and *cystophora*, except in furcocercal form. They apparently come from *Limnæus palustris* var. *corvus*. Feeding experiments were not successful in determining the final host.

Peripatus leuckartii Oviparous.[4]—Dr. Arthur Dendy thinks he has evidence to show that *Peripatus leuckartii*, unlike the rest of its congeners, lays eggs. He had one male and three females of the

[1] *Lizusa*, *Lizzia*, *Lizzella* and *Margellium* are included as young forms which can occasionally become sexually mature.

[2] Zool. Anz., xiv, 368, 1891.

[3] Am. Nat., xix, 310, 1885.

[4] Zool. Anz., xiv, 146, 1891.

species in a small vivarium, and on examination he found under a bit of rotten wood some twelve or fifteen eggs which closely resembled those taken from the oviducts of other females except that the chorion was exquisitely sculptured. This evidence is relative, not absolute, as will readily be seen.

North American Thysanures.[1]—Alex. Macgillivray catalogues the known species of North American Thysanura, enumerating 74 species. The list leads off with the three species of Scolopendrella.

Stridulation in Lepidoptera.—At the meeting of March 1, 1892, of the Zoological Society of London, Mr. G. F. Hampson read a paper on stridulation in certain Lepidoptera. The author attributed the clicking sound described by Darwin as produced by various species of the South American genus Angerona, and confirmed by Wallace and other observers, to the presence of a pair of strong corneous hooks with spatulate ends attached to the inner margin of the fore wings close to the base, and surrounded by a membranous sac which acts as a sounding board. An account was given of a similar sound produced by the males of a Burmese moth of the family Agaristidæ and of a buzzing sound in an allied Australian form, both of which have a patch of ribbed hyaline membrane below the costa of the fore wing. The sound was attributed to the friction of spines, attached, in the former to the first pair of legs, in the latter to the second pair, upon the ribbed membrane. A description was then given of the transformation of the costal half of the hind wing in the Noctuid genus Patula into a large scent gland, and of the manner in which this had distorted the neuration.—Zool. Anz., No. 387.

A New Compound Ascidian.—W. Garstang describes[2] under the name Archidistoma, a new genus of the Ascidian family Distomidæ which is of especial interest since "it exhibits the first stage in the evolution of the cœnobitic type of colony from the Social Ascidian type, in which the zooids are entirely free and irregularly placed; in *Archidistoma aggregatum* the clumps of zooids (primitive cœnobia) have no common cloaca, but the cloacas of the individuals are usually situated towards the center of the groups. The second stage is exhibited in such a compound Ascidian as *Synoicum turgens* or *Circinalium concrescens,* in which each of the isolated clumps of zooids possesses a common central cloaca."

[1] Can. Entomol., xxiii, 267, 1891.

[2] Zool. Anz., xiv, 422, 1891.

Lateral-Line Organs of Sharks.—Ewart and Mitchell, in two papers[1] describe the sensory canals in Læmargus and Raia. The lateral-line organs consist of two systems of canals and of minute sensory follicles. The so-called sensory canals open to the surface of the skin by numerous tubules, while the ampullar canals are enlarged at the proximal ends, and give off neither tubules nor branches. Previous authors have described the sensory canals according to position; Ewart and Mitchell think innervation should be the basis of grouping. The canals receive their nerve supply, 1, from the facialis or, 2, from the vagus, the latter innervating the lateral canal. Of the canals innervated by the facialis three main stems are recognized, the supraorbital, supplied by the ophthalmic; the infraorbital by the buccalis; and the hyomandibular by the corresponding divisions of the facialis. The further details have little interest in an abstract, except the great extension of the hyo-mandibularis canal over both surfaces of the pectoral fin of the skates. In this connection the editor may state that some as yet unpublished researches tend to show that these canals promise to throw considerable light upon the phylogeny of the fish-like vertebrates.

Parallel Color-Patterns in Lizards.—In The Naturalist for December, 1891, p. 1135, I called attention to the identical color-patterns displayed by the varieties of our two South-western species of Cnemidophorus, *C. tessellatus* and *C. gularis*, and the general similarity these species present to the *Lacerta muralis* of the Mediterranean countries, in color variations, which are pointed out by Prof. Eimer. Having recently published a paper on Cnemidophorus in the Transactions of the American Philosophical Society, I give two plates illustrating these facts. Plate xviii represents the two species of Cnemidophorus, A to F the *C. tessellatus*, and G to L the *C. gularis*. A is the color-pattern of the young and half-grown; B is *C. t. perplexus* B. and G., adult; C, *C. t. tessellatus* α; D *C. t. tessellatus* β; E *C. t. tessellatus* γ; F *C. t. rubidus* Cope; G *C. gularis* young and half grown; H do. adult; I and K, *C. g. sealous* Cope α and β; L *C. g. semifasciatus* Cope. Plate xix represents some of the variations of the *Lacerta muralis*. A represents the young coloration; B the var. *L. m. campestris*; C the *L. m. albiventris*; D *L. m. maculata*; E *L. m. tigris*.—E. D. Cope.

[1]Zool. Anz., xv, 116, 118, 1892.

A New Genus of Bats.[1]—Dr. Harrison Allen considers the *Histiotus maculatus* of Mr. J. A. Allen as the type of a new genus for which he proposes the name Euderma. It is a Plecotian genus without muzzle processes and with two premolars in the lower jaw.

Human Rumination.—It is well known that there are some persons who possess the power of regurgitating their food, causing it to pass from the stomach back to the mouth, and to do this voluntarily; this is the difference between rumination and involuntary regurgitation, or eructation. Heredity plays here, perhaps, an important role; the imitation is frequent, and men are more addicted to the habit than women. Rumination is a physiological phenomena, which can be of use in studying the digestive functions; it is also a pernicious habit, or, at least an unpleasant one. Many persons have contracted this habit because it gives them pleasure, because the food thus regurgitated has an agreeable flavor; one of them said that "it was sweeter than honey and more delicious." The point of departure toward this habit is often accidental; it is caused by the ingestion of some irritating and indigestible substance. A well known physiologist became a ruminant while endeavoring to obtain some gastric juice from his own stomach. He swallowed a sponge to which was attached a thread; the irritation of the foreign substance caused a regurgitation which persisted for some time. There are some who regularly practice rumination for the pleasure experienced; others, only after they have eaten hastily. In the latter case it is a hygienic measure. The regurgitated food has an agreeable flavor as long as the stomach is sound and well, otherwise it is disagreeable.

In order to be rid of this habit, which, to say the least is an unpleasant one, the food should be thoroughly masticated and all care should be taken to exclude irritating and indigestible substances. In extreme cases it is sometimes necessary to limit the patient to liquid foods for some time.—(Revue Scientifique, March, 1892.)

[1]Proc. Phila. Acad., 1891, 467.

EMBRYOLOGY.[1]

Growth of the Ovum in the Fowl.[2]—Prof. M. Holl, of Gratz, has made a detailed study of the formation of the membranes, acquisition of the yolk and change in the character of the nucleus of the hen's egg, while in the ovary.

In the chick just hatched the ova form "nests" or clusters of naked cells, each about 14 μ thick, beneath the germinal epithelium and surrounded by the connective tissue stroma of the ovary. Each ovum, when about 20 μ thick becomes enveloped by a delicate *tunica adventitia* that is really formed by some of the stroma cells flattening themselves out around the ovum; it is thus a product of the stroma, not of the ovum, though it is usually called the "vitelline" membrane.

Later the "follicular epithelium," so called, is formed around the ovum by the arrangement of spindle shaped stroma cells in a single layer about the ovum. The author would call this second stroma membrane the *granulosa.*

These epithelioid cells increase so that the follicle is made up of several layers. External to it a thin *membrana propria* is formed by a few flat stroma cells. Finally the stroma itself is arranged in a system of concentric fibres and cells, external to the three membranes it has formed. The ovum and its fellow epithelial cells are thus excluded from any part in the formation of the egg membranes.

The large central nucleus of the ovum is at first central, but makes two successive migrations towards the surface of the cell, becoming flattened on one side and applying this side close against the *tunica adventitia,* when it takes up its permanent position in the ripe egg. Irregularities in its contour are regarded, not as pseudopodia, but as artificial products. The nuclear net-work of chromatin has at first a fine mesh, but undergoes complex changes leading to its breaking up into minute granules, which are distributed throughout the nuclear substance.

The body of the ovum at first presents a wide-meshed system of non-staining material: this is then replaced by a fine-meshed system of staining material radiating out from staining centers, the *dotterkern,* next the nucleus. This mesh-work becomes finer and finer and its

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]Prof. M. Holl: Sitzb. Akad. Wiss. Wien, 1890, pp. 311–369, pl. I.

interstices occupied by very minute granules, which are the starting point for the formation of the yolk spherules.

These yolk spherules form first near the nucleus and then towards the periphery of the egg. In this way is formed what appears to be the white yolk at the center of the ripe egg.

The remaining mass of yolk is made gradually by the conversion of successive layers of granules into yolk spherules. These layers are formed outside the central mass and close to the *tunica adventitia*, the last formed being the outermost. Some of these layers become converted into yellow yolk.

The peripheral granular layer of the egg grows and is nourished by the aid of the *zona radiata*. This peculiar layer is formed, now, between the *tunica adventitia* and the granular outermost part of the egg and remains as long as yolk formation continues. Though apparently a part of the ovum, this layer is, the author holds, in reality a system of parallel radiating fibrils which are merely processes of the follicle cells! These processes pass through holes in the *tunica adventitia* and at the other end become continuous with the mesh-work of the peripheral part of the ovum.

The follicle (stroma) cells and the ovum are thus united by intercellular processes, by which nutrient liquids may pass into the ovum.

When the egg finally escapes from the ovary some fibrillar remnants of this *zona radiata* remain adherent to the inner side of the *tunica adventitia* and thus cause the somewhat double nature of the "vitelline" membrane.

No observations were made upon the proper maturation of the ovum, though certain peculiar bodies in the nucleus are regarded as preparations for the formation of the polar cells.

Sexual Glands in Mammals and in the Fowl.[1]—Dr. J. Janosik, from sections of embryos of the fowl, the sheep, the hog and man, has arrived at the following interesting conception of the nature of the genital glands, in reference to sex.

A proliferation of cells of the germinal epithelium gives rise to strings of cells which are to be later developed in the male (testis) but which in the female (ovary) are not developed. A second proliferation of the epithelium gives rise to the nests of cells to form the ova of the ovary.

The gland, ovary or testis, thus has a central, older, part that may become the male portion, and a peripheral, younger part that may

[1]Janosik: Sitzb. Akad. Wiss. Wien, 1890, pp. 260–288, pl. I.

become the female portion. If both derivatives of the germinal epithelium were to develop, both the first central, and the second, peripheral, there would result an hermaphrodite gland.

The epithelial cells that form the sperms in the male would be thus somewhat older, ontogenetically, than the epithelial cells that form the ova in the female.

The Tail in the Human Embryo.—Dr. Franz Keibel[1] having sectioned and reconstructed several human embryos of different ages endeavors to decide the difficult question as to the value of the posterior end of the trunk, as to the existence and magnitude of what may be truly called the tail.

In spite of the various criteria used by His in determining what is to be regarded as the caudal region, such secondary changes as the movements of the pelvis made known by Rosenberg make the problem much more difficult than might at first appear. The author counting back from the head reckons those mesoblastic somites or vertebræ as caudal which would be posterior to the sacrum of the adult.

From the present material and the observations of His and Fol it seems that embryos of 4 to 6 mm. have a true projecting tail with chorda, mesoblastic somites, medullary tube and also a caudal intestines or post-anal gut. Later the number of caudal segments may be as many as six while the intestinal tube closes first at the base then towards the tip of the tail.

This caudal appendage is thus more perfectly developed in the embryo than in the adult: a fact which the author would add to the various facts of human and comparative anatomy, which he enumerates as evidence of the former existence of a complete tail in the ancestors of man.

Embryonic Veins in the Limbs of Amniota.—Dr. F. Hochstetter[2] finds in the limbs of the rabbit, chick and the lizard a remarkable similarity in the earliest condition of the venous supply. Moreover the anterior and the posterior limbs are at first identical in this respect.

In such an embryonic limb, before the digits are apparent, there is an axial vessel serving as an artery and sending blood by radiating branches towards the single vein, which borders the pad-like foot. This border vein continues up the limb, on both anterior and posterior

[1]Archiv. f. Anat. Phys., 1891, pp. 356–388, plates 19–20.

[2]Morph. Jahrbuch, 17, 1891, pp. 1–42, plates 1–3.

sides, to connect with certain vessels in the trunk. Thus each limb contains a venous loop forming a border along the free tip of the limb, the foot.

As the digits form, the border vein becomes interrupted, but radial vessels remain between the digits. Various changes take place in the limbs of the venous loop, one limb soon disappearing so that but one of the original two connections between foot and trunk remains.

Later changes become too complex to be easily expressed in small compass and may be here passed over. Most of the work was done upon living specimens, so that the direction of blood-flow and certain interesting changes from artery to vein function could be observed.

In the Anamnia the author found in a Triton that though there is no border vein yet there is a vascular loop for each limb and later, when the digits appear successively, there is a duplication of this loop for each digit, producing a resulting arrangement not utterly different from the later stages of the border vein in the Amniota.

Endothelium and Blood Corpuscles in the Amphibia.[1]—Dr. Shwink has made a detailed study of the formation of the endothelial lining of the heart and chief vessels and of the origin of the blood corpuscles in the Anura *Bufo vulgaris* and *Rana fusca* as well as in the urodeles *Triton alpestris* and *Salamandra atra.* In these amphibians the author finds evidence that the cells forming the blood vessels arise, in part at least, in the entoblast and not in the mesoblast. Though he cannot exclude the mesoblast entirely, yet he fails to find evidence that it has any part to play in forming the endothelium, and regards the yolk-entoblast as forming most, if not all, of the endothelium cells.

The blood corpuscles arise later than the endothelial cells. They are made in three blood-islands posterior to the heart into which they are then carried by the movement of the serum. The nuclei of the corpuscles do not come from yolk spherules but from pre-existing nuclei which divide actively in the first formed corpuscles.

In the Anura the blood corpuscles are not formed from the mesoblast but from the yolk-entoblast. Yet this may be a recent departure from a phylogenetically older formation of blood cells from some mesoblast that is now incorporated in the entoblast. In the urodeles the evidence is conflicting and at present the author is unable to to decide whether the blood-islands are of mesoblastic or of entoblastic origin or in part of both.

[1]Morph. Jahrb., 7, 1891, pp. 288–331, plates 17–19.

ENTOMOLOGY.

Notes on Harvest-spiders.—In my previous papers upon the Phalangiidæ I have used the genus Oligolophus of C. Koch adopting the characters given by Semon, in his Arachnides de France, who, in a footnote (v. VII, p. 238), says: "Le genre Oligolophus a été créé par le Dr. C. Koch de Francfort pour le *P. terricola* et ses congénères, et caractérisé par l'absence de fausses articulations aux metatarses de la premièrc paire de pattes, tandis que dans son genre Opilio les fausses articulations sont bien visibles. Ce caractère est pour moi de peu de valeur; aussi, tout en adaptant le genre Oligolophus, lui donne je une composition et une caractéristique differentes de celles de son auteur. En effet, les fausses articulations sont tres-variables dans une meme èspece, et elles manquent aux metatarses de la premiere paire chez les *alpinus* et *morio* que le Dr. C. Koch laisse dans le genre Opilio, tandis quèlles sont faiblement rudiqueés chez le *glacialis*, qui en est si voisin. Je joins aux Oligolophus les quelques especes pour lesquelles M. le Dr. T. Thorell a formé le genre Mitopus."

This was published in 1879, the genus having been first erected in 1872. In 1876 Dr. Thorell published his Mitopus. This distinguished arachnologist has kindly sent me a copy of the paper in which his characterization occurs, and in a recent letter says: "I see you have (with M. Semon) adopted the name Oligolophus instead of Mitopus Thor. The genus Oligolophus was founded by a Dr. Carl or Karl Koch of Wiesbaden (later of Frankfort a.M.) for those forms of the genus Opilio C. L. Koch in which the metatarsi are without "articulationes spurio." But this is a character of so little importance that even in the same specimen you may find that one side of the body belongs to the genus Opilio of K. Koch while the other side belongs to his Oligolophus. As also in my Mitopus the metatarsi may want the "'articulationes spurio.' Mitopus is founded on quite another, and as I believe, a good and constant character—the presence of a strong tooth on the under side of the first article of the mandibles.'"

In view of these facts I now give preference to Mitopus rather than Oligolophus. The characters of Mitopus according to Dr. Thorell are as follows: First joint of mandibles armed below with a strong, pointed tooth. Ocular tubercle not constricted, denticulate above, of nearly equal length and breadth. Claw of palpus not denticulate;

maxillary lobes of second pair of legs similar to Phalangium; the skin is not coriaceous.

Our species of this genus are *pictus* and *ohioensis*.

The two western species described by Dr. H. C. Wood as *Phalangium favosum* and *P. nigrum* which on account of their hard skin I have heretofore referred with some doubt to the sub-family Sclerosomatinæ prove not to belong there, as I learn from Dr. T. Thorell to whom I submitted specimens, and who writes that they represent undescribed genera. It seems to me that they differ sufficiently from the Phalangiinæ to form a distinct subfamily. For *P. favosum* I have erected the genus Trachyrhinus, which is characterized as follows:

Body very hard: dorsum a large plate with a rough, coarsely punctate surface. Front margin of cephalothorax furnished with two denticulated tubercles. Eye eminence prominent with two rows of large tubercles having spinose tips. Legs rather long, thickly beset with spinose tubercles. Pores on margin of cephalothorax rather small, oval. Palpal claw smooth; inner distal angle of femur very slightly, and of patella quite strongly developed. First joint of mandible furnished with a tooth on lower surface.

One species *Trachyrhinus favosus* (Wood) inhabiting the Western States.

The *P. nigrum* of Dr. Wood may serve as the type of the new genus Mesosoma, having the following characters:

Dorsum a firm hard plate thickly studded with small hemispherical tubercles. Eye eminence of nearly equal height, length and breadth, covered with similar tubercles, and not carinated. Palpi moderately robust not branched, and furnished with many tubercles; palpal claw pectinate. Tooth on underside of first joint of mandibles. Legs short, coriaceous, robust. Lateral pores on upper margin cephalothorax very distinct, subcircular.

One species, *Mesosoma nigrum*, found in the western and southwestern States. It is possible that the western form described by Wood may be different from Say's species. The latter records his species as common in Georgia and the Carolinas, but I think none have since been reported from this locality.

These two species belong neither to the Phalangiinæ nor the Sclerosomatinæ as now restricted by European authors, having some characters of each. They apparently form a new sub-family which may be called the Mesosomatinæ, and be defined as follows:

Body very hard, most of the dorsal segments being united in a firm dense plate. Posterior dorsal and the ventral segments having their

margins developed into thin overlapping plates, especially in the males, the ventral plates being sometimes obsolete in gravid females. Pores on margin of cephalothorax distinct. Anal piece unique. Maxillary lobe of palpi with two tubercles.—CLARENCE M. WEED.

The Cattle Tick.—The Journal of Com. Medicine and Veterinary Archives for July, 1891, and January, '92, contains two articles by Dr. Cooper Curtice upon this insect (*Boöphilus bovis*). The first contains an account of the life history; while the last presents the habits of the species. Dr. Curtice refers this species to the genus Boöphilus (ox loving), "in which the rostrum and palpi are very short; the capitulum wider than the combined width of the palpi and rostrum; the second and third segments of the palpi nearly equal and each widest about the middle where the sides project in an angle; eyes present." This species has been formerly referred to the genus Ixodes.

Dr. Curtice recommends kerosene emulsion for destroying the cattle ticks, especially when the cattle are shipped north, because of the supposed relation which the ticks bear to Texas fever. I wish here to call attention to a remedy for this pest, with a few additional facts as to the ticks being the means by which the germs of Texas Fever are disseminated.

In regard to remedy there is but one objection to kerosene emulsion and this is that in order to keep the cattle free from the ticks the emulsion would have to be applied almost daily. This is especially true where the cattle are pastured in herds where they may be supplied with a fresh lot of ticks every day. A far better remedy consists in feeding the cattle equal parts of sulphur and salt. This should not be given occasionally, but kept where the cattle may have free access to it at any time. That this remedy will keep the cattle free if only given occasionally is not claimed, nor is it true. But it *is* very effectual, however, if the sulphur and salt be kept where the cattle may have free access to it. It is probable that the sulphur acts as a repellent owing to the fact that it is very largely eliminated from the body through the skin. It is hence used in the treatment of many skin diseases. This matter of a proper remedy is of vast importance throughout the South where the cattle have some portions of the body constantly covered with the ticks throughout the summer and autumn months. The decrease of flesh and milk consequent from the attack of the ticks must be considerable.

That ticks are the means of disseminating the germs of Texas fever is a much disputed point. There seems to be some doubt, also, as to

the exact nature of the germs of Texas fever, some claiming it to be a small protozoan attacking the red corpuscles of the blood, while others claim that the true germ is an ovoid bacterium, between a micrococcus and a bacillus, not directly attacking the red corpuscles. That ticks *may* be *a* means of spreading the germs of Texas fever is quite probable. Last October Dr. Billings of Nebraska obtained pure cultures of an ovoid bacterium from ticks sent him from here. Several calves inoculated with the cultures were almost immediately taken with Texas fever. This would seem to show that the germs may exist in the ticks, but that they spread the germs to northern cattle or that they are the principal means of the dissemination of the germs are as yet open questions.—HOWARD EVARTS WEED, Mississsippi Agricultural College.

Recent Bulletins.—That the experiment stations are doing important work in disseminating information concerning injurious insects, as well as in original investigations of them, is shown by the numerous bulletins upon the subject. In New Mexico, Prof. Townsend issues as Bulletin No. 5, of his station, a discussion of certain fruit insects attracting attention in that region. In Iowa, Prof. Osborn discusses "Lice affecting domestic animals," (Bulletin No. 16) and in Oregon, Prof. Washburn briefly describes (Bulletin No. 18) a large number of injurious species. A particularly attractive bulletin (No. 40) comes from the Kentucky Station. It is a discussion of "Some common pests of the farm and garden" by Prof. H. Garman. Like all of Prof. G.'s publications it is carefully prepared, and is well illustrated, several of the figures being new. It is a pity that more station bulletins cannot be gotten up in as good shape as regards proof-reading, typography and paper as this.

The subject of spraying has received attention in bulletins from the Pennsylvania, New Jersey, Michigan, Massachusetts, and other stations.

Notes and News.—At a recent meeting of the Cambridge Entomological Club the following officers were elected for the current year: President, Rev. W. J. Holland, Pittsburgh, Pa.; Secretary, Roland Hayward; Treasurer, Samuel Henshaw; Librarian, S. H. Scudder; Executive Committee, S. H. Scudder and J. H. Emerton.

In a recent *Journal of the Columbus Horticultural Society* (v. VI, No. 4) Mr. F. M. Webster has a readable paper on "Insect Parasites," with fifteen illustrations.

According to *Science* the entomological collection of the late Henry Edwards has gone into the possession of the American Museum of Natural History, New York City. Friends in theatrical circles subscribed $10,000 and the Museum $5,000 for its purchase. The collection includes more than 350,000 specimens.

From *Psyche* we learn that a study of California butterflies, and especially their comparison with those of Eastern America and Europe, leads S. H. Scudder, in the *Overland Monthly* for April to claim that the highest type of human civilization is to arise on the Pacific coast.

Prof. C. H. T. Townsend of the New Mexico Agricultural College is vigorously prosecuting his studies of American Tachinidæ, as is shown by numerous recent papers in entomological periodicals.

Prof. J. B. Smith has recently published as Bulletin No. 851 of the U. S. National Museum a Revision of the Species of Mamestra.

In an admirably illustrated paper Dr. C. V. Riley gives, in recent *Insect Life* (v. IV, Nos. 7 and 8) an interesting account of the larger digger wasp (*Sphecius spheciosus*), concluding with this suggestive paragraph: "If man could do what these wasps have done from time immemorial, viz., preserve for an indefinite period the animals he feeds on by the simple insertion of some toxic fluid in the tissues, he would be able to revolutionize the present methods of shipping cattle and sheep, and to obviate much of the cruelty which now attends the transportation of live stock and much of the expense involved in cold storage."

MICROSCOPY.[1]

Notes on Bone Technique.—In preparing bone for sectioning it is well to have fresh material taken from a young individual. After the soft parts are removed the bone is cut into short pieces and then macerated in water until the medulla is easily washed out; they are then ready to section.

Preparations nearly as good as those obtained by maceration may be made from fresh tissue. Thin sections are cut from the desired region with a fine saw; from these the medulla should be carefully washed out under a jet of water; they are then ground until the desired thinness is reached, again washed, dried and mounted. The grinding may be done with a file or on a revolving grindstone or with emery on a dentist's lathe[2], or between pieces of compact pumice stone, followed

[1]Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2]Nealey, Am. Mon. Micro. Jour., 1884.

by hones of finer grain, and finally polished on a piece of smooth leather or buckskin covered with powdered chalk.

Another method is to grind the bone on a glass plate with emery of different degrees of fineness. This may be accomplished by pressing the section down with the fingers, or it may be fastened to a cork by means of sealing-wax or thick balsam. It is then polished on one side until smooth; then the wax or balsam is melted, the section turned and polished on the other side until the required thinness is reached. Only compact tissue can be prepared by this method. The spongy tissue, being very delicate, must be imbedded before sectioning. This may be done according to the method given by Wiel,[1] Koch's copal method[2] or a mixture of ten parts resin and one of ordinary wax may be used.[3] The objects should be placed in a very fluid, but not too hot, solution of the above, and after a short time lifted out with forceps, leaving as much of the mixture as possible adhering to the object. When cool the mass may be cut into thin sections and ground in the ordinary way, washed and cleared in turpentine and mounted in balsam. If an opaque preparation be desired the imbedding mass is removed by washing in chloroform and the section dried between sheets of filter paper and mounted.

A very convenient method is given by Ranvier.[4] The fragment of bone is placed in a syrupy solution of gum arabic, and when saturated it is exposed to the air until the gum thickens; it is then hardened in alcohol. From this mass sections are made and ground in the usual way, except alcohol is used to wet the hone instead of water. When ground sufficiently thin the gum is dissolved in water and the section is ready to mount. According to the method of mounting either opaque or transparent preparations are made. For the study of Haversian canals, lacunæ and canaliculi the former is better. To obtain an opaque preparation a drop of balsam is placed on the slide and heated over a spirit lamp to evaporate the oil; it is then cooled and tested by a needle. If hard the balsam is again softened and the dry section placed in it; at the same time a drop of balsam is placed on the cover glass which is applied, and the whole transferred to a cold surface; this should be done as quickly as possible in order that the balsam may solidify before penetrating the cavities. If, on

[1]Zeit. f. wiss. Mikros., Bd. iv, p. 200, 1888. Abstract AM. NAT., xxiii, p. 520, 1889.

[2]Whitman's Embryological Methods, p. 233.

[3]Ehrenbaum, Zeit. f. wiss. Mikros., Bd. i, p. 14, 1884.

[4]Traite, p. 249.

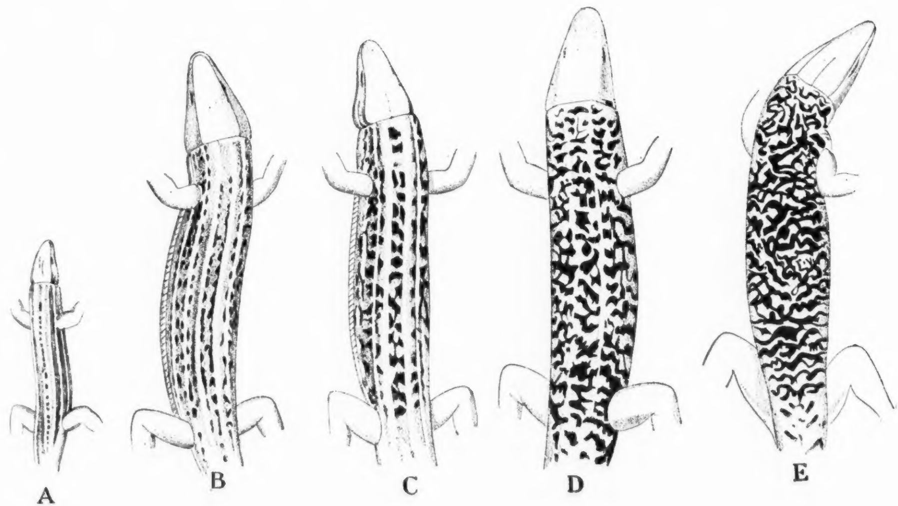
the other hand, we wish to study osseous lamellæ or stained preparations, the section is first placed in a solvent of balsam, then transferred to a warm solution of balsam until the entire canalicular system is filled, when it is mounted.

Methods of Decalcification.—*Thomas' Nitric Acid Method.*[1] —Pieces of fresh or hardened calcified tissue, bone, tooth, etc., are placed in 95% alcohol until completely saturated, then transferred to a solution consisting of five parts 95% alcohol and one part c.p. nitric acid, in which they are left for several days. The liquid should be occasionally shaken and renewed until the tissue is completely decalcified. The process is very rapid, owing to the solubility of the potassic nitrate in weak alcohol. Very large pieces may be decalcified in from two to three weeks. The object is then placed in a vessel of 95% alcohol, to which calcium carbonate is added until there is a residue of the precipitate. This mixture should also be occasionally shaken and renewed. After several days litmus paper no longer shows an acid reaction; the object is left in the fluid a day or two longer, then washed with a spray of alcohol, which removes the most of the calcium carbonate deposited on the surface. The extremely fine particles remaining do not in any way interfere with the cutting. If one wishes to avoid this deposition the object may be wrapped in filter paper. This, however, requires a longer time for the removal of the acid. By this method large pieces of very dense tissue are very rapidly decalcified and then completely freed from the acid; the soft parts undergo but little swelling, while the tissue stains as readily as before decalcification.

Haug's Phloroglucine Method.[2]—This is one of the most rapid decalcifying agents; the structures are perfectly preserved with the exception of blood, which is considerably changed. The introduction of the method is due to Andeer,[3] who used the phloroglucine in combination with hydrochloric acid, but with variable results. By substituting nitric acid perfectly uniform results are obtained. The solution is prepared by warming 1 g. phloroglucine in 10 c.c. of c.p. nitric acid. This must be done slowly and carefully; soon a dark ruby solution is obtained; to this is added 50 c.c. distilled water. If a larger quantity of the fluid is desired 10 c.c. acid are added to every 50 c.c. of water until the volume has reached 300 c.c., which is the limit of the protective

[1]Zeit. f. wiss. Mikros., Bd. viii, p. 191, 1891.
[2]Zeit. f. wiss. Mikros., Bd. viii, p. 8, 1891.
[3]Centrabl. f. d. med. Wiss., 1884, pp. 193–597.

PLATE XIX.



Lacerta muralis.

influence of the phloroglucine. In this solution the pieces of well fixed and washed material are placed. The decalcification is very rapid. Fœtal or young bones as well as those of the lower vertebrates are decalcified in half an hour. Older and harder bones require only a few hours. A 35% solution may be used for teeth, yet it is rarely found necessary to use stronger than 20%. If less rapid decalcification be desired the following formula may be used:

Phloroglucine	1 part.
Nitric acid	5 parts.
Alcohol, 95%	70 parts.
Distilled water	30 parts.

When decalcified the bones are washed in running water for about two days. The sections stain well and do not fade.

SCIENTIFIC NEWS.

A Grand Honorary Prize placed at the disposal of the Boston Society of Natural History by the late Dr. William J. Walker "for such investigation or discovery as may seem to deserve it, provided such investigation or discovery shall have been made known or published in the United States at least one year previous to the time of award," has been unanimously awarded to Prof. James D. Dana.

In recognition of the value of the scientific work of Prof. Dana and in testimony of the Society's high appreciation of his services to science the maximum sum of one thousand dollars has been awarded.

For the annual Walker Prizes a first prize of one hundred dollars has been awarded to Baron Gerard de Geer, of Stockholm, for an essay entitled "On Pleistocene Changes of Level in Eastern North America," and a second prize of fifty dollars to Prof. William M. Davis, of Cambridge, for an essay on "The Subglacial Origin of Certain Eskers."

The newly organized Chicago University has called bodily the whole Biological Department of Clarke University. The following persons from Clark have already accepted positions as professors, assistants, fellows, etc., at Chicago: C. O. Whitman, H. H. Donaldson, F. Mall, F. Boas, G. Baur, S. Watase, W. M. Wheeler, E. O. Jordan, C. L. Bristol, H. P. Johnson, F. R. Lillie, A. D. Mead.

The results of the great Japanese earthquake in Gifu-ken, where the damage was greatest, are thus summarized: 4889 deaths, 12,311

persons wounded, 44,203 dwelling houses completely and 21,378 partially demolished, 23,379 damaged and 4159 burned after collapse, in addition to 1744 other buildings demolished or damaged. The total number of buildings thus affected in the ken was therefore 88,011.

Recent Deaths.—Charles Smith Wilkinson, government geologist, in Sydney, N. S. W., Aug. 26, 1891, aged 46 years. August von Pelzeln, the well-known ornithologist, in Vienna, Sept. 2, 1891. P. J. F. Lowrey, lepidopterologist, at Clapham Park, England, July 24, 1891, at the age of 30 years. Dr. Max Quedenfeldt, a traveler and collector of Coleoptera, in Berlin, July 13, 1891, aged 40 years. Friedrich Wilhelm Meves, the ornithologist, in Stockholm, in April, 1891, aged 77 years. Cesare Tapparone Canefri, the conchologist, August 6, 1891, at Quattordio. Dr. Edward Killias, in Chur, Switz., Nov. 14, 1891, aged 63 years; he was a botanist and entomologist. George J. Bettany, December 2, 1891, at the age of 42. He was best known for his labors in condensing the papers of the late W. K. Parker into the useful volume "Morphology of the Skull."

Indian Literature.—The Bureau of Ethnology has just issued a collection of Omaha and Ponka letters collected and edited by James Owen Dorsey. Seventy-seven of these letters are included, each being given first in interlinear and then in translation.

Another most valuable publication for the student of American archæology, published by the same bureau, is Dr. Cyrus Thomas' "Catalogue of Prehistoric Works East of the Rocky Mountains." This is arranged first by States and then by counties, and is compiled from various sources. Like any similar first catalogue there are necessarily many omissions and mistakes, but the work will be useful, not only as a record of what is now known, but also as a means of collecting more information and correcting errors. Notes will be thankfully received by Prof. Thomas.